Technology Review

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Did we need to drop the bomb?

A HISTORIAN WEIGHS THE EVIDENCE

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GETTING TOUGH WITH MEDICAL WASTE

NEURAL NETS GO TO WORK *MINING WITH MICROORGANISMS*

RADICALLY RECYCLED CAMERAS

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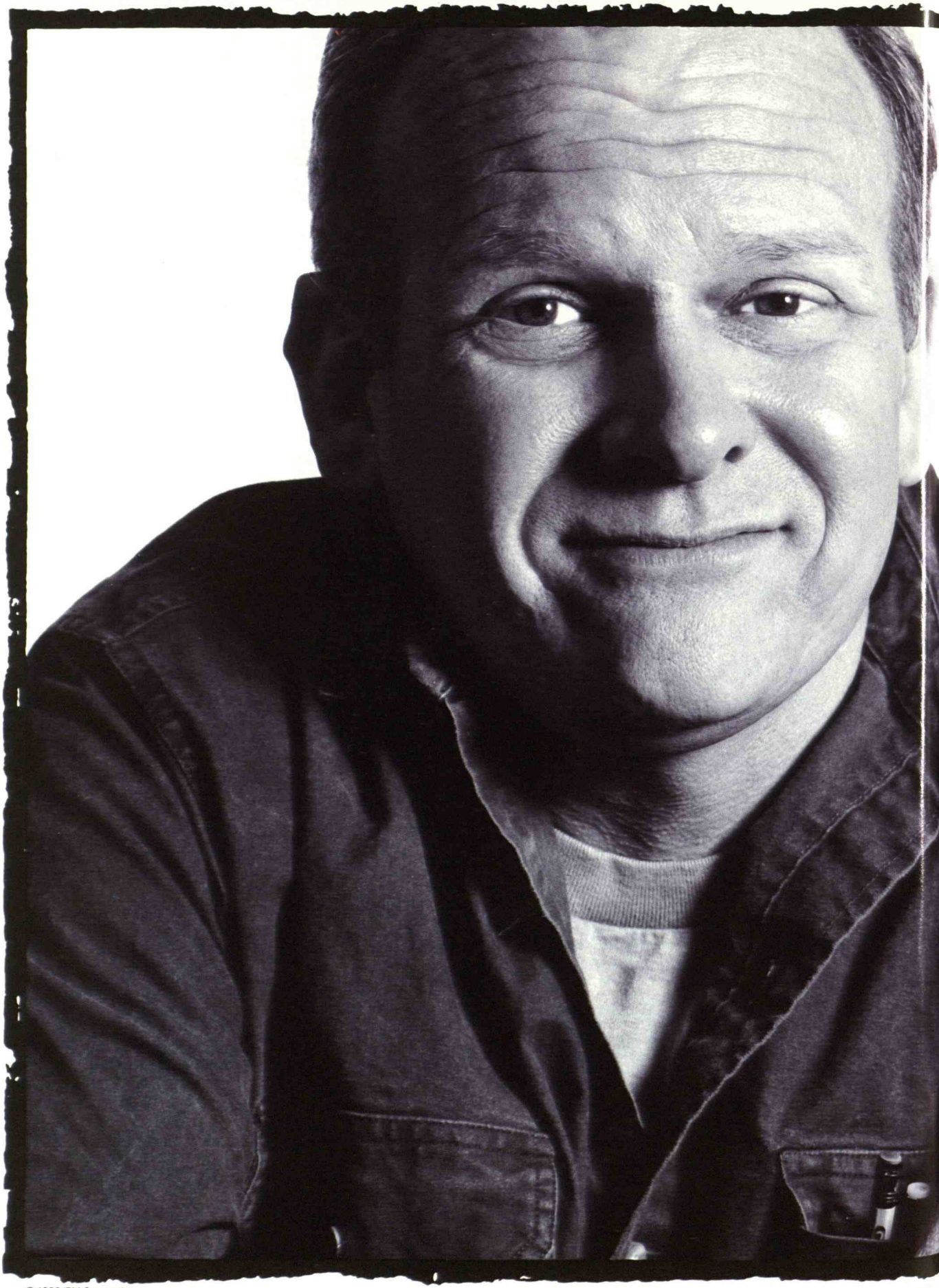

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AUGUST/SEPTEMBER 1990

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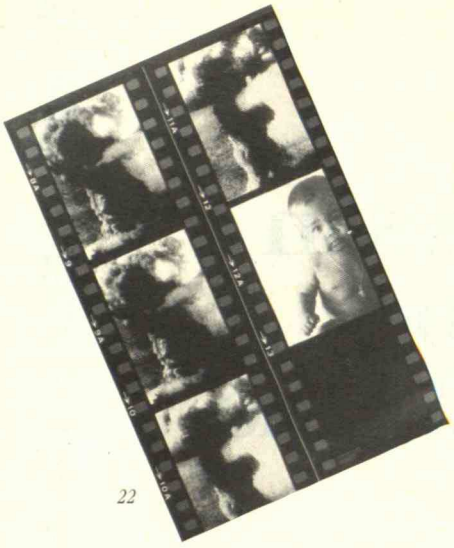

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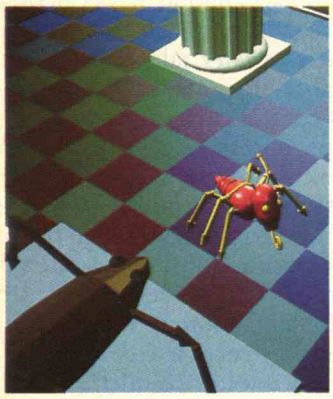

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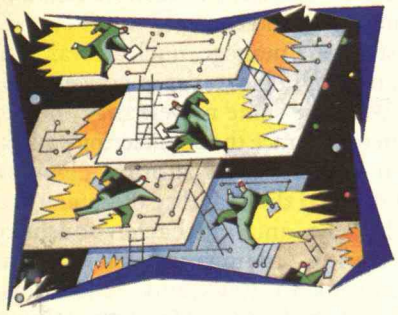

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DEPARTMENTS

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FirstLine

How Star Wars Helped

A couple of years ago, the Strategic Defense Initiative (SDI), President Reagan's call to render nuclear weapons "impotent and obsolete" by building a shield against missiles, was the central arms-control issue. Now Presidents Gorbachev and Bush have agreed to proceed with START, seeking significant reductions of strategic weapons while leaving missile defense as a footnote to be dealt with later. Yet the meteoric career of Star Wars, as it came to be known, produced a legacy worth remembering. By at once promising protection from the terrors of the arms race and seeking to extend that race to the ultimate frontier, Star Wars helped illuminate the insane trap we were in.

Looking back, it is hard to tell when Star Wars was really finished. Was it only recently, when Edward Teller, the physicist who gained Reagan's ear with visions of an x-ray laser that could destroy 100,000 targets in one blast, lost confidence in that technology? Was it last year, when Gorbachev realized he could proceed with START because Congress itself would prevent serious SDI testing? Was it when Reagan left office, or when Gen. James A. Abrahamson, the visionary leader of SDI, was replaced by a bureaucrat? Was it in 1987, when the American Physical Society declared it would be at least a decade before scientists could determine if directed-energy weapons were practical? Was it the day after Reagan's Star Wars speech, when Deputy Secretary of Defense Paul Thayer gathered Pentagon officials and said, "What are we going to do with this mess?"

Dating Star Wars' demise is problematic because it was always the engineering equivalent of a perpetual motion machine. Critics emphasized this from the start. Any shield to protect the public against nuclear weapons must be "leakproof": one explosion could kill a million people. But as Gerold Yonas, the chief scientist of the SDI program, admitted to *Los Angeles Times* reporter Robert Sheer in 1985, "Nobody believes in 100 percent leakproof defense. Nobody believes in 100 percent anything that's ever worked on military systems." Engineers could be reasonably confident of overcoming gravity to reach the moon but could never be certain of outwitting an intelligent human adversary.

If this was obvious, why was the Star Wars debate so protracted? Reporters have no litmus test for truth but do have generally agreed lists of authoritative sources, and one of these is the president of the United States. If he says perpetual motion is possible, reporters may quote members of the American Physical Society who disagree, but cannot ignore the statement. In fact, the statement is so controversial that it will repeatedly make the front page.

> *In promising to stop the arms race by extending it to space, Star Wars illuminated the insane trap we were in.*

Moreover, though the essential problems with Star Wars were simple, the debate grew complex. There was a kind of inevitable logic to this development. In a familiar form of mathematical proof, you posit a statement, use it to deduce something absurd, and thus prove the original statement false. In this case, the assumption that engineers can defend the nation against nuclear weapons led to numerous, intricate contradictions. One was that programmers can be sure that the most complex software ever written will work the first time. (There can be no test of thousands of nuclear warheads streaming toward the U.S.) Even new versions of word-processing programs have bugs that make them "crash," for example, displaying exclamation marks all over the screen and destroying a document.

But as a fairy tale, SDI did yield a valuable insight. Before 1983 the arms-control community had come to accept deterrence—the notion of preventing nuclear war by threatening a retaliation that would destroy civilization. This frightful logic had produced its own chain of absurdities, such as the notion that the United States needs to continually improve technologies of nuclear destruction to deter the Soviets "at every level of conflict." The entire arms-control community agreed on the need to strengthen "communication, command, and control," or "C-cubed," systems to manage nuclear war. But managing nuclear war is nonsensical.

With the same naivete that allowed him to embrace the engineering equivalent of perpetual motion, Reagan challenged the morality of deterrence. When he and Gorbachev outlined sweeping reductions of nuclear weapons in Reykjavik, the arms-controllers shuddered for the stability of deterrence and made it clear that the doctrine requires a minimum of thousands of nuclear warheads. The two heads of state had to pull back, but the arms race never looked quite so sensible again.

Ultimately, Star Wars illuminated the essential illogic of that race. When President Truman and other U.S. leaders knew they had the atomic bomb in 1945, they apparently saw it as a guarantor of peace. With American innocence in control of the ultimate technology—we have long thought of ourselves as untainted by the evil and intrigue of foreign peoples—the world could rest at ease. Of course, events did not and could not work out that way. In the 1980s Star Wars revived the vision of an all-powerful America as global benefactor. This time critics were more swift and merciless about the contradictions of the vision, and that contributed to a somewhat safer world. ■

JONATHAN SCHLEFER

What if there
were
an aerospace
all-star team?

There is—the engineers and scientists just named Technical Fellows of The Boeing Company. They are individuals who have earned reputations for exceptional judgment and competence in their disciplines, and for practical, yet innovative reasoning. (Front Row, L-R) **Richard B. Hall**—precision measurements and laser applications, Boeing Aerospace & Electronics, Seattle; **Wayne E. Woodmansee**—nondestructive testing, Boeing Commercial Airplanes, Seattle; **Coe E. Wescott**—electronic design, Boeing Military Airplanes, Seattle; **Nicholas Albion**—flight control systems, Boeing Helicopters, Philadelphia;

(Back Row) **Weightstill William Woods** – sensors, Boeing Aerospace & Electronics, Seattle; **Mervin C. Vincent** – ow observables, Boeing Military Airplanes, Seattle; **Frank C. Fickeisen** – flight controls and systems engineering, Boeing Commercial Airplanes, Seattle; **Albert M. Erisman** – scientific computing and numerical analysis, Boeing Computer Services, Seattle; **Paul E. Rubbert** – aerodynamics and computational fluid dynamics, Boeing Commerical Airplanes, Seattle; **Ulf Goranson** – structures engineering, Boeing Commercial Airplanes, Seattle; **George T. Campbell** – communications and systems engineering, Boeing Aerospace & Electronics, Seattle.

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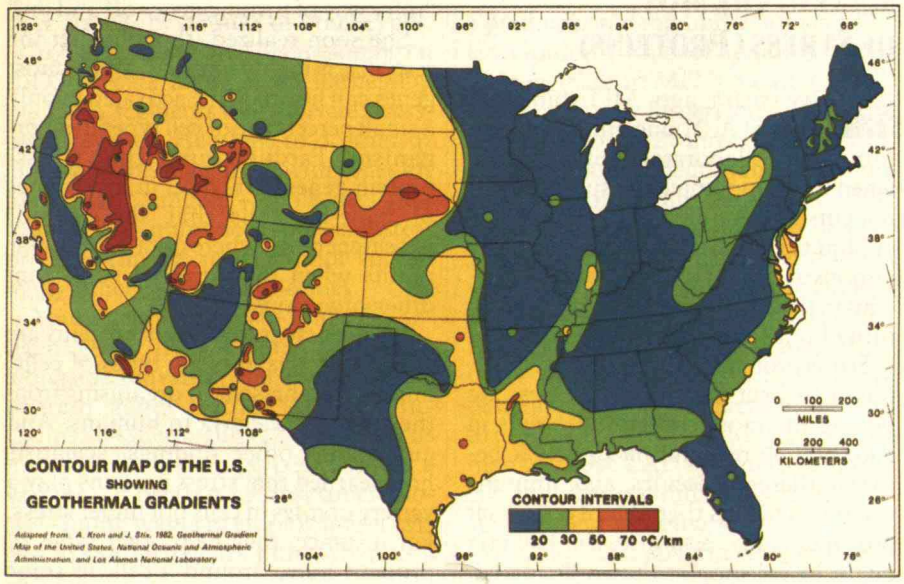
MIT Reporter



The well depth needed to reach hot dry rock (HDR) areas depends on the geothermal gradient. In much of the East, few studies have been conducted, so scientists estimate gradients conservatively.

Hot Rocks

In an era when environmental and supply issues are again swirling around fossil-fuel use, MIT's Energy Lab director Jefferson W. Tester has an idea that could spark new interest. For 17 years Tester has studied the notion of extracting energy from the granite that lies a mile or more beneath such widely separated areas as New Mexico, Maryland, and southwestern England.

This form of geothermal energy, which differs from other kinds in that it is not emitted at the earth's surface, is known as hot dry rock (HDR). With Los Alamos National Laboratory staff member Donald W. Brown and consultant Robert M. Potter, Tester writes in a recent Los Alamos report that the hottest and most concentrated HDR sources could provide energy at a cost competing with oil—5 to 6 cents per kilowatt-hour—within the decade. Moreover, although the authors acknowledge that no one energy source can supply all needs, the amount of HDR could be "orders of magnitude larger than ... all fossil and fissionable resources."

"No one knows how much might be recoverable," Tester says. But "there's plenty of it."

Tester and his colleagues also claim that HDR energy would be environmentally sound. Unlike oil and coal, HDR energy would not produce acid-rain precursors or carbon dioxide, which heats up the atmosphere. The only sure environmental effect, the researchers say, would be in HDR mining areas.

To obtain the energy, engineers would drill pairs of wells down to hot rocks. They would then use water pressure to create fractures that would serve as artificial reservoirs for the heat. Cool water would be sent through the first well of each pair, and then, after heating in the fractures, it would return through the second well at temperatures of 475 to 575° F.

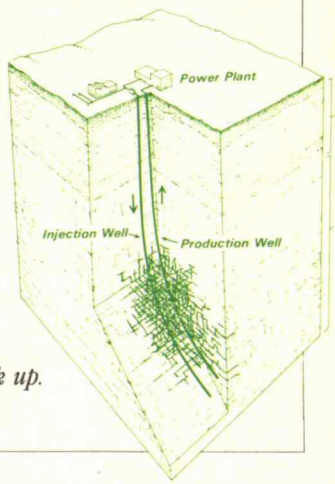
The drilling would cause the usual small-scale environmental changes associated with that activity, Tester remarks. He and his colleagues point out that there is also a small seismic risk, if circulating water is lost in the rock and creates pressure in the surrounding area.

Before HDR drilling can take place on a national scale, Tester says, researchers need to demonstrate that long-lasting reservoirs of sufficient size can be created. And for the cooler, less concentrated HDR sites, they must find a way to make drilling costs two to three times lower.

This work requires money, of course. U.S. research funds peaked at $15 million annually in fiscal years 1979 and 1980, then dropped as the Reagan administration grappled with the budget and showed less interest in funding alternative-energy research, according to Ted Mock, director of the geothermal division of the U.S. Department of Energy (DOE). For fiscal year 1990, Congress appropriated $3.6 million for HDR research.

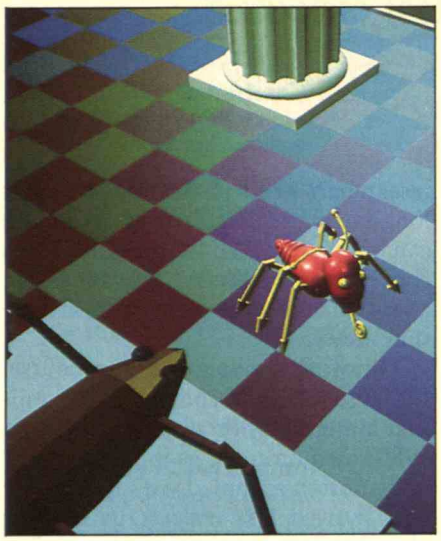
The funding declined before commercialization was possible, notes Mock, who agrees with Tester that HDR could provide commercial energy by the turn of the century given enough research dollars. In 1987, a National Research Council panel studying geothermal technology concluded that $106 million would be necessary to complete reservoir testing at two specific sites.

So far, relatively few people are versed in HDR research. While not everyone concurs with Tester's estimate of when HDR energy could be commercially viable, a one-year flow test that DOE expects to conduct in 1991 near Los Alamos should yield more information. The test, which will employ wells drilled 12,000 feet down, will indicate whether the water flows correctly and heats sufficiently. ■



Engineers could extract HDR energy by sending water down into fractured rock, letting it heat there, and then drawing it back up.

DIAGRAMS: LOS ALAMOS NATIONAL LABORATORY



A "Cootie" scoots along the floor under the gaze of an animated cockroach. Researchers at MIT's Media Laboratory have developed both creatures based on models of a cockroach's walking behavior.

COCKROACH ANTICS

One way to check that robots can safely operate in hazardous, unpredictable environments is to set up computer simulations of robotic movements. But how can the simulations be deemed satisfactory? To help answer that question, three members of MIT's Media Laboratory have devised a simulated insect, based on neurophysiological models of a cockroach's walking behavior.

The animated insect can respond to a changing environment by altering its speed, direction, and gait just like the real critter, explain graduate students Michael McKenna and Steve Pieper and computer graphics associate professor David Zeltzer in a paper published in *Proceedings of the 1990 Symposium on Interactive 3D Graphics.*

The researchers put their character through a series of tests. If the animal receives no inputs, it wanders and pushes objects aside. When faced with a hand that pops up, however, the insect halts. If the hand tries to grab the insect, it flees to a hiding place using a faster gait. McKenna, Pieper, and Zeltzer have also developed the simulation so that the animal can "heel" by tracking a hand. Alas, that's a fanciful addition to a real cockroach's behavior—imagine leading these insects out of doors. ■

MAKING THE MOST OF STRESS (PROTEINS)

Five years ago MIT biologist Richard A. Young and a group of European collaborators got a surprise when they pinpointed the specific components of the tuberculosis and leprosy bacteria that trigger immune responses. Out of the thousands of proteins in these organisms, the key ones all turned out to be stress proteins.

Stress proteins, produced by cells exposed to heat and other stresses, are among the most common proteins in nature. The recognition of a link between these molecules and immune responses means that identifying what provokes such responses in bacteria might be far simpler than anticipated.

The findings, along with similar discoveries made later with other pathogens, have resulted in efforts to shed new light on many kinds of infectious diseases, says Young. The work has also fueled inquiries into whether autoimmune disorders like rheumatoid arthritis—diseases in which the immune system attacks the body's own tissues—arise when an individual's stress proteins provoke immune responses.

For his part, Young, who is also a staff member at the MIT-affiliated Whitehead Institute for Biomedical Research, is seeking to create an AIDS vaccine. It would work by exploiting the exceptional ability of stress-protein genes to trigger the manufacture of such proteins under stressful conditions.

The Stress Response

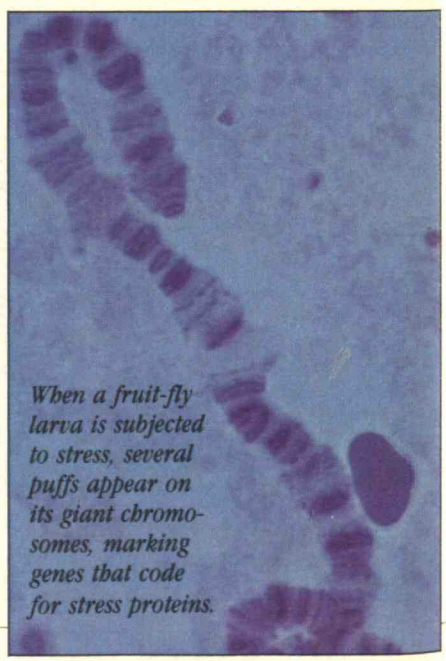
Italian biologist Ferruchio Ritossa discovered stress proteins in the 1960s. He found that heating fruit-fly cells always activates a particular small group of genes, which in turn produce what scientists now call stress proteins.

In the early 1970s, Mary Lou Pardue, an MIT biologist, began following up on Ritossa's work. Pardue, interested in basic aspects of gene regulation, says she saw the stress response mainly as a "nifty way of turning genes off and on."

She soon realized, though, that the response is highly unusual. While most genes can normally be activated in only a small percentage of cell types in an organism, Pardue found that stress-protein genes turned on in most types of fruit-fly cells that she heated. Researchers elsewhere obtained similar results when they stressed cells from other organisms.

It's now clear that stress proteins are not only active in many types of cells, but are also present in organisms from the simplest bacteria to humans. And along with other findings, scientists have learned that stress proteins play a variety of roles in cells not under stress. For instance, they help other types of proteins move around a cell, in some cases by temporarily unfolding them.

Why stress proteins serve as immune-response *agents provocateurs* is unclear, but Young says it may relate to their universality. As higher organisms evolved, he theorizes, their immune systems took advantage of the fact that these proteins were common to a wide range of infectious agents. If the hypothesis holds, it suggests that immune mechanisms are highly efficient. Encountering one type of pathogen could prepare the immune system for



When a fruit-fly larva is subjected to stress, several puffs appear on its giant chromosomes, marking genes that code for stress proteins.

PHOTOS: MIKE McKENNA; MARY LOU PARDUE

later attacks by a range of other types.

Young's current goal of developing an AIDS vaccine depends on harnessing the DNA segments that activate stress-protein genes. He plans to do that by linking up this machinery with genes for particular "antigens"—molecules that touch off an immune response. (Stress proteins can be antigens, but so can many other types of molecules.)

Young's approach is to splice the antigen genes from certain pathogens alongside activation segments of stress-protein genes within the bacillus Calmette-Guerin (BCG). Though this harmless bacterium is itself used as a vaccine—it protects against tuberculosis—Young wants to employ it as a carrier for antigen genes rather than as a vaccine per se.

Young says that white cells called macrophages will likely ingest the BCG after it is injected into the body. "The macrophage's job," he explains, "is to engulf foreign agents, digest them into little bits, and present some of these to the rest of the immune system." He thinks that with the BCG under this kind of assault, the activation machinery of their stress-protein genes will go into high gear, turning on the antigen genes. The antigen then might trigger an appropriately vigorous immune reaction.

To assess the potential of this vaccine technology in protecting against AIDS, Young is collaborating with researchers at the New England Regional Primate Center. Together they are attempting to create a vaccine for an AIDS-like disease in monkeys. The scientists hope to conduct animal tests of that vaccine before the end of the year.—*RICHARD P. ANTHONY is a free-lance writer who covers biology and medicine.* ■

COMPUTER-AIDED DESIGN: HOW MUCH AID?

Computer-aided design (CAD) systems could be used much more effectively than they are at many companies today, say David C. Robertson, a graduate student, and Thomas J. Allen, Gordon Y Billard Fund Professor of Management at MIT's Sloan School.

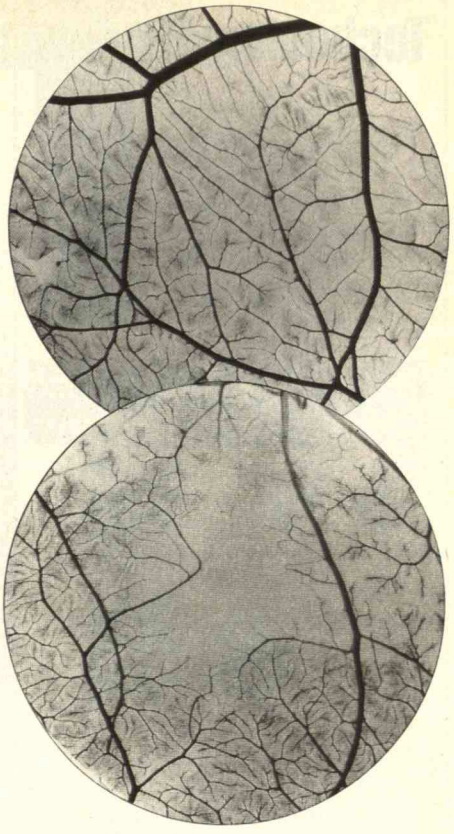
According to Robertson and Allen's interpretation of 29 interviews with engineering department managers, more than half the group—16—view CAD systems as electronic drafting boards. Many managers have not had training in CAD systems, and therefore emphasize using the technology in a way that they understand. Only six managers say CAD systems are also valuable in designing products differently—in three dimensions, say. And just seven managers use CAD systems to improve communication internally and with vendors and customers.

Among these enlightened managers, one automaker has each group that is developing a part of an automobile share its design information on the company's CAD system. That way, the groups can negotiate directly, when, for instance, one needs more space for its part. And other firms have provided major customers with a CAD terminal so that they can indicate precisely and quickly where a product may have a problem.

After interviewing a broad array of engineers as well as managers, Robertson and Allen warn that CAD systems may not reduce the time needed for developing designs—a common selling pitch—unless manufacturers use the devices as more than new-fangled drafting boards. ■

INHIBITING CAPILLARIES—AND MAYBE CANCER

Scraped knees wouldn't heal if the body couldn't form new capillaries. But several serious diseases—cancers, some forms of glaucoma, rheumatoid arthritis, and blindness caused by diabetes—can develop when that ability runs amock. Concern over a therapy for these illnesses has prompted Robert S. Langer, Jr., MIT chemical and biochemical engineering professor, and two colleagues to identify a protein that inhibits capillary growth.



The compound CDI inhibits capillary growth in a fetal chick membrane (bottom). The effect is noticeable in contrast with a similar membrane to which a control substance has been added. Such findings could aid research on cancer and other diseases.

Harvard Medical School instructor Marsha A. Moses, technician Judith Sudhalter of Boston's Children's Hospital, and Langer write in a recent paper in *Science* that they have extracted the protein from the cartilage of a cow's shoulder blade. In previous work, Langer and former MIT graduate student Anne Lee had found that shark cartilage halts tumor growth.

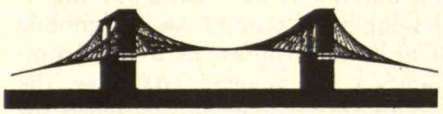
Langer and his colleagues obtained the protein, which they call cartilage-derived inhibitor (CDI), using a salt extraction process and a series of precipitation and chromatography steps. Having found that bovine CDI inhibits growth of embryonic chicken tissue, the researchers want to clone the substance, examine how it works, and compare it with CDI they hope to extract from other types of cartilage. Cartilage from sharks particularly interests Langer's group because that creature's whole skeleton is made of it. ■

PHOTOS: MARSHA A. MOSES

Letters

SCIENCE AND LIBERALISM

In "Why Scientific Education Is Liberal" (*TR February/March 1990*), Jonathan Schlefer cites the 1940s failure and reconstruction of the Tacoma Narrows bridge as exemplary of the scientific community's openness to progress and change. Yet the same failure and reconstruction also tells another story. Almost 60 years before the collapse of this bridge, another noteworthy suspension structure, the Brooklyn Bridge, was completed. Today it remains one of the most admired civil engineering works of all time. Furthermore, with its visually provocative cable stays and stiffened deck, it stands as a successful solution to the effects of crosswinds, which so swiftly wrecked the Tacoma Narrows.



How is it that a design principle understood and realized in 1880 was ignored in the design of a similar structure at a later date? The answer can be found in none other than the engineering community's rapid and willing acceptance of new design methods between the late nineteenth and early twentieth centuries. That is, the same characteristics of the scientific outlook that Mr. Schlefer praises contributed to the catastrophic and unnecessary failure of a major civil engineering work.

The design of the Brooklyn Bridge by John Roebling was based on nineteenth-century theories of mechanics and the accumulated experience of suspension-bridge engineers. The sensitivity of these structures to dynamic loads was well understood, mainly through observations of earlier bridge behavior, including several failures quite similar to that of the later Tacoma Narrows. But early in the twentieth century, the engineering community adopted new methods for calculating the deflection of suspension structures. While such methods more accurately predicted the effect of gravity loads, they did not satisfactorily account for the effect of crosswinds. The rapid adoption of these methods and the abandonment of earlier, less "scientific" but reliable techniques contributed directly to the inadequate design of a generation of suspension bridges, including the Tacoma Narrows. In assessing the Tacoma Narrows disaster, engineers returned to the works of the nineteenth century to rediscover the principles applied then.

To separate the roles of tradition and progress into two opposed camps serves only to aggravate the difficulty that already surrounds the roles of "scientific" and "humanistic" thought in many arenas. Just like the humanities, the scientific/technical community has a proudly guarded tradition of ideas—for instance, a method of systematic and objective inquiry whose origins can be traced back at least to the philosophy of Socrates and his disciples. By the same token, the humanities have undergone revolutions in outlook since Homer's time. The question I would consider is not which of these two schools of thought is more open to progress, as both seek to improve the human condition through greater understanding of ourselves and our world. Rather, I would turn my attention to the issue of why each so frequently lacks tolerance for the values of the other.

JOSEPH IANO
Philadelphia, Pa.

Although agreeing with its penultimate conclusion, I strongly take issue with several points Jonathan Schlefer makes in "Why Scientific Education is Liberal." His fundamental assertion is that liberal-arts education is conservative in outlook, while scientific/technical education is liberal in the sense of encouraging a willingness to confront change. But Mr. Schlefer confuses liberalism as a philosophy with liberal arts as applied to an educational path. While a willingness to confront change may be the essential result of a liberal philosophy, it seems an insufficient reward for the labors of an education.

Also, in asserting that a liberal-arts education is conservative in outlook, Mr. Schlefer points to several allegedly

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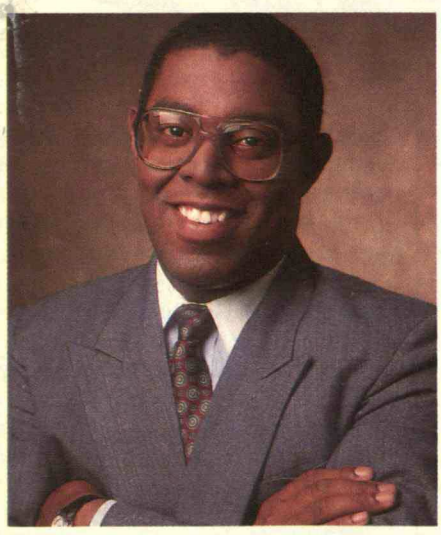
"DO IT RIGHT."



Victor Simon
Senior Petroleum Engineer
Texaco

"We have a corporate responsibility to do business with a conscience. This includes ensuring that the issues we are all passionate about—the environment and the quality of life—are not overlooked."

Victor Simon is a Texaco Senior Petroleum Engineer. He is committed to making certain that Texaco's oil and gas operations in the Eastern U.S. are conducted in a manner consistent with environmental safeguards.

"This responsibility includes more than just being attentive to government regulations. In every step of our operations, from obtaining emission permits to ensuring on-site safety, simply meeting legislated standards isn't enough. We can and *do* exceed such standards when we believe it is the right thing to do. We have an obligation to our employees, our contractors, our customers and the people in the communities around us to act with their interest in mind, not just react."

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It's also people like Victor.

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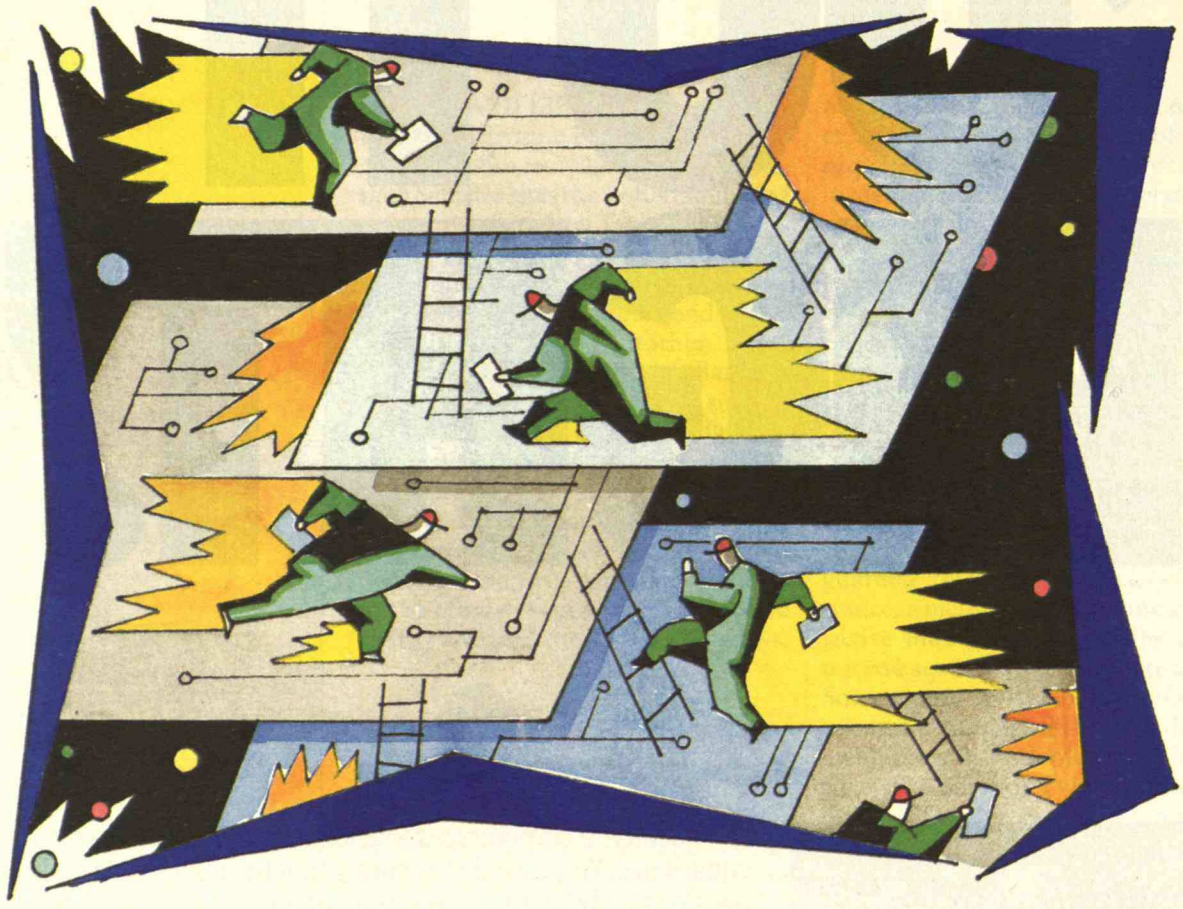
TEXACO – WE'VE GOT THE ENERGY.

Trends



The Computer Speed Barrier

For every 11 inches a computer signal travels, a billionth of a second is lost. That didn't concern many computer designers in the past, but it has become a thorn in the side of those who build high-performance workstations, minicomputers, and mainframes. These computers have become so fast that the distances separating chips—not the chips themselves—are a major bottleneck.

Consequently, designers are now preoccupied with how to pack integrated circuits tightly together to minimize the path that electrical signals must traverse. "Interconnection technology is vital to developing newer, faster computers," says Jack Raffel, a researcher at MIT's Lincoln Lab.

The most rapidly emerging approach to interconnection is the multi-chip module. Several computer manufacturers are investigating the idea, and a number of mainframe makers—including Digital, IBM, and NEC—already use it. Multi-chip modules compress the capabilities of four 12-inch-square printed circuit board assemblies into a single 5-inch-square module.

Typically made of silicon or ceramic, the module contains ultra-fine conductive lines as small as .006-millimeters wide and made of aluminum, copper, or gold. The lines compactly link several dozen microchips, each of which is mounted to the module without the bulky, protective plastic or ceramic housings that characterize printed circuit board assemblies.

Multi-chip modules can cost four times as much as conventional printed circuits to manufacture, and they are difficult to test and repair. But Digital recently adopted them for its high-end VAX 9000 mainframe, and technical workstations are expected to be the next big market for the modules. According to Donald Marshall, a senior hardware consultant at Digital's high-performance business unit, without the modules, "you could not build the kind of systems we are building."

Connection in Three-D

Multi-chip modules are probably just a step in the interconnection search. Over a dozen firms and universities worldwide are exploring the potential of "wafer-scale integration."

In conventional chipmaking, 40 or more microchips are fabricated from a single six-inch silicon disk, called a wafer. Before the chips are connected to one another, they are cut from the wafer, individually packaged and tested, and assembled onto a printed circuit board. In wafer scale, the disk is never cut up, and connections between microchips are made directly on it.

Wafer scale virtually eliminates excess space, as well as the handling of

ILLUSTRATION: ROBIN JAREAUX

each microchip and the many electrical bonds that can deteriorate and fail. But for two decades, this technique has eluded most attempts to commercialize it. The biggest hurdle has been finding a way to isolate the defective chips that normally occur on a silicon disk, according to Raffel. Often half the chips on a wafer are defective. Conventional approaches discard bad chips before assembly, but that isn't an option in wafer-scale integration.

Under Raffel's direction, a Lincoln Lab team has developed working prototypes of a promising solution that uses lasers to create the connections among good chips. Each link is actually made of two tiny semiconductors that short together to form a circuit when the laser is applied. The Lincoln group, which is building several wafer-scale devices, is working with Micron Technology of Boise, Idaho, to apply the concept to computer memories.

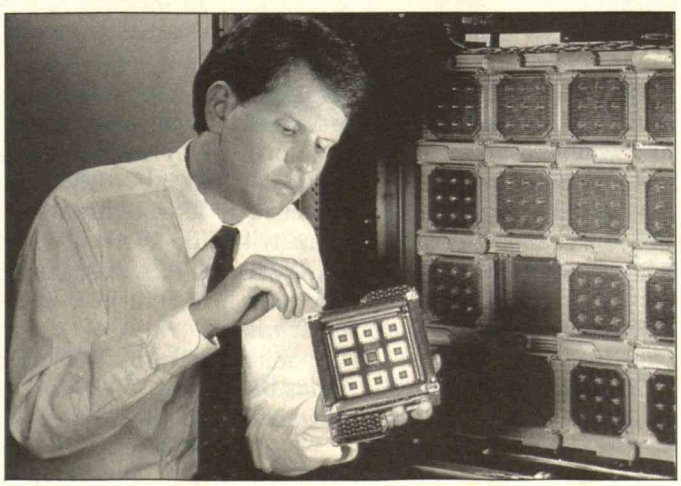
One wafer-scale effort, by a U.K.-based start-up, has reached the market. Anamartic Ltd. incorporates a logic circuit into each chip that either connects or disconnects the chip with its neighbors based on commands from a controller not on the wafer. The company sells a pair of 6-inch wafers that together hold 40 megabytes of memory. The two wafers and associated circuitry occupy half the space of the densest printed circuits, according to Hank Bardsley, engineering manager at Anamartic's U.S. subsidiary.

These developments all involve "horizontal technology"—that is, chips sit side-by-side. "Z-plane technology" promises to do for computer builders what skyscrapers do for real estate. Under development by Irvine Sensors of California, z-plane stacks chips on top of one another. As in multi-chip modules, conductive lines connect the chips, except in this case the lines run on the side of the stack.

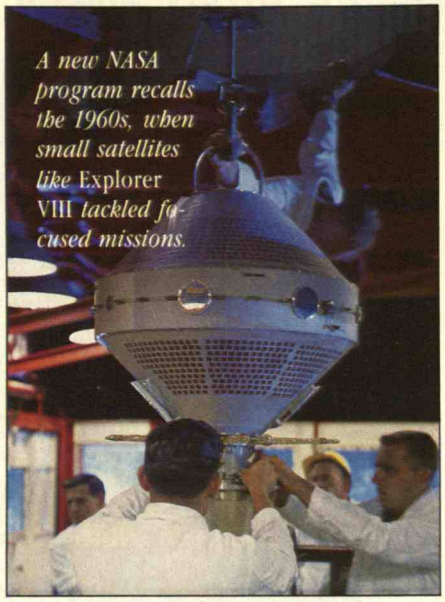
A z-plane stack can hold 20 to 100 chips, packing up to 40 megabytes of memory into a space the size of two sugar cubes, according to Ken Leon, Irvine's operations vice-president. That amount of memory normally fills an 8-inch-square printed circuit board.

Z-plane is years from commercial use. Among other problems, the heat that integrated circuits produce in such close quarters could cause them to self-destruct. But like a skyscraper in a crowded city, z-plane packs the most into a space. Says Paul Vanderbilt, a technical staff member at TRW, "We live in a three-dimensional world. It's just inevitable that we go that way." ■

MICHAEL LEIBOWITZ is a San Francisco-based writer specializing in semiconductors and computers.



In designing faster computers, the minute distances separating microchips are a major bottleneck. For its VAX 9000 computers, Digital is dealing with the problem by adopting so-called multi-chip modules, which link several dozen chips.



A new NASA program recalls the 1960s, when small satellites like Explorer VIII *tackled focused missions.*

NASA's New-Old Satellites

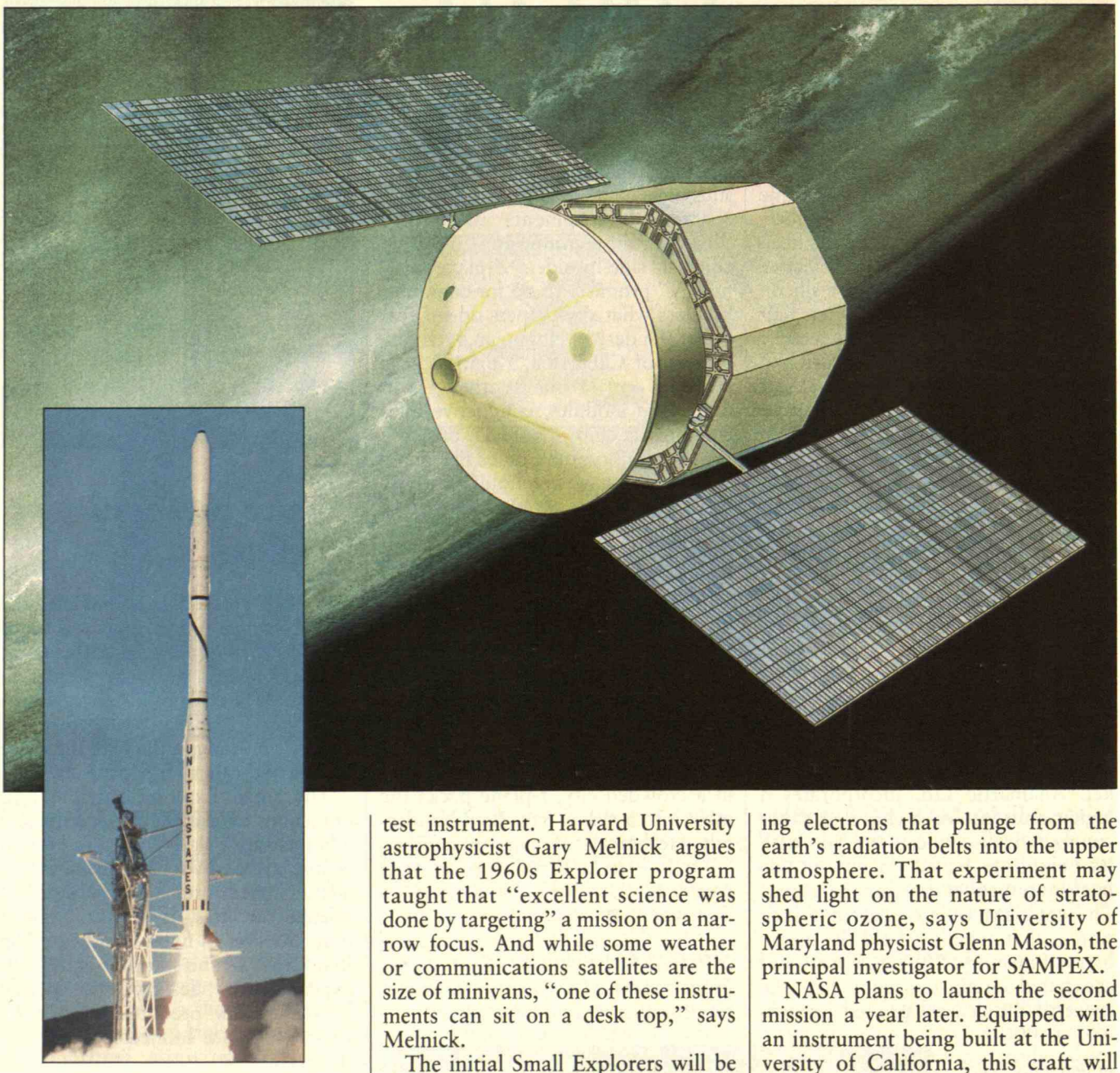
Sixties nostalgia has invaded the National Aeronautics and Space Administration (NASA). Officials at the Goddard Space Flight Center in Greenbelt, Md., are overseeing a program that recalls an era before the agency's preoccupation with the space shuttle and other large projects.

The Small Explorer Satellite Program aims to rekindle engineering and administrative skills that have been in eclipse at NASA for nearly two decades. Named after a 1960s series of science satellites, it aims to launch nine satellites in five years, beginning in mid-1992. The satellites will be inexpensive and designed for specific scientific tasks, predominantly in the region of space immediately around the earth.

Nine instruments doesn't compare in number to the satellite-resplendent 1960s, when NASA launched dozens of Explorer-class orbiters. Still, the new Explorers program puts NASA back into the science-satellite business. In the 1970s, NASA had turned its attention to the larger projects, and it has launched just three smaller missions since 1981.

Compared with the 1960s Explorers, the current effort will "deliver more science for the dollar," asserts Ronald Adkins, who recently retired as project manager. He explains that

PHOTOS: DIGITAL EQUIPMENT CORP.; NASA



NASA hopes that the Small Explorer Satellite Program will "deliver more science for the dollar." Scout rockets (inset), not the space shuttle, will carry the first Small Explorers into orbit.

NASA intends to keep the price of each satellite under $30 million, excluding launch costs. That is about one-tenth the expense of large weather or navigation satellites and far less than military spy satellites, which can cost a half-billion dollars.

The Explorers will be cheaper because most will bear a single, small test instrument. Harvard University astrophysicist Gary Melnick argues that the 1960s Explorer program taught that "excellent science was done by targeting" a mission on a narrow focus. And while some weather or communications satellites are the size of minivans, "one of these instruments can sit on a desk top," says Melnick.

The initial Small Explorers will be launched on Scout rockets from Vandenberg Air Force Base in California. First up will be the Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX). Carrying an instrument package developed at the University of Maryland, Caltech, and Germany's Max Planck Institute, SAMPEX will weigh 385 pounds and circle the earth in a low orbit around the poles. It will study ions the sun blows off in solar flares as well as interstellar atoms believed to have drifted into our solar system.

SAMPEX will look closely at speeding electrons that plunge from the earth's radiation belts into the upper atmosphere. That experiment may shed light on the nature of stratospheric ozone, says University of Maryland physicist Glenn Mason, the principal investigator for SAMPEX.

NASA plans to launch the second mission a year later. Equipped with an instrument being built at the University of California, this craft will study the density and energy of electrons in the auroral regions at the earth's two poles. Harvard's Melnick is principal investigator for launch number three, the Submillimeter Wave Astronomy Satellite. Scheduled for 1993, it will observe galactic gas clouds that researchers believe play an integral role in forming stars.

Return of the Engineers

Small satellites will allow scientists to chase eclectic goals. "Some missions require special orbits," Mason ex-

PHOTOS: NASA

plains. It doesn't make sense to put a large satellite loaded with many experiments into an orbit suitable for only one of those tasks. Moreover, rockets can reach some special orbits that the space shuttle can't—such as the pole-to-pole course of SAMPEX.

The Small Explorer satellites will also provide a flexibility that is impossible with "do-everything" missions. "Sometimes there is a timeliness to the questions you want to ask," Mason notes. "You may make a discovery and want to follow up on that [with a second mission] quickly."

NASA hopes that the Small Explorers will help restore engineering skills to Goddard. Mason explains that the Carter and Reagan administrations "felt that NASA shouldn't compete with the aerospace industry." Places like Goddard became contract-management centers, while aerospace companies did design and construction. One result, Mason argues, was predictable: NASA project planners now manage "contracts on systems where they don't really have any engineering experience."

"For 15 years, we haven't hired engineers," says NASA's Ron Adkins. "Now, we hope to have older engineers train newly hired younger people to build satellites." Although the scientific equipment for the satellites will be designed outside NASA, these instruments and other components will be assembled at Goddard.

The new Explorers may even prove to be a management lab for NASA planners, who seek better ways to handle small projects. For example, managers of such programs may need to learn to make compromises they would never face in more ambitious settings—such as choosing not to buy some redundant parts. That choice might increase the risk from instrument failure, but it would also keep overall costs down and might yield designs that need less redundancy. ■

THOMAS KIELY is a Technology Review *contributing writer.*

Making the Workplace Safe

A recent National Safe Workplace Institute study documented that the United States has the worst occupational-safety record of any industrialized nation. In 1986, on-the-job accidents killed 3.6 people for every million hours worked. Japan, with 2.3 deaths per million worker-hours, came in a distant second.

Thus, it's natural that safety advocates are putting forward fresh ideas about how to better enforce safety and health laws. One suggestion—joint labor-management committees in every major workplace—is gaining enthusiasm among labor activists, public officials, and even some corporations.

At General Motors, where collective-bargaining agreements with the United Autoworkers Union (UAW) have mandated joint committees since 1973, corporate head of health and safety Robert Wiensek says such a program "is the only way to go if you want progress in health and safety." At the Occupational Safety and Health Administration (OSHA), number-two person Alan McMillan agrees: "I'm a strong advocate of [labor-management committees]. They bring the safety and health of workers right down to the operating level, out of the plant manager's or president's suite."

Wiensek says GM's committees make the "resolution of problems a lot easier." He attributes the company's 17-year lack of work stoppages to the arrangements. And he adds,

PHOTO: EARL DOTTER

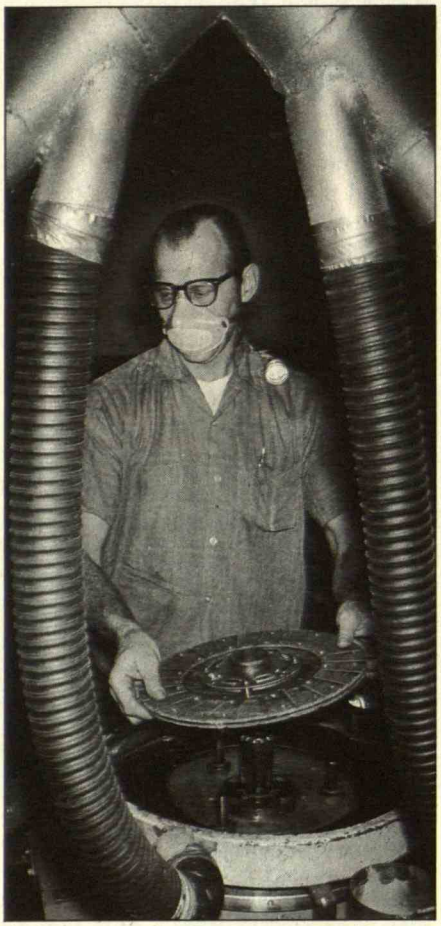
"Our plants are much safer than before the program started."

Although it could, OSHA hasn't required employers to set up joint committees. In any case, says the AFL-CIO's health and safety director Margaret Semanario, unions would prefer legislation instituting joint committees to an OSHA regulation. That would make joint committees "national policy rather than the policy of one particular administration," which could change more easily.

Congress hasn't seen any proposals yet, but state legislators have introduced bills in New Jersey and California. In both cases, joint labor and management worksite committees would take primary responsibility for ensuring shop-floor safety. The committees would regularly inspect workplaces and have enough authority to do their job—including the right to shut down unsafe work processes. The employer would pay for both labor and management representatives to receive safety training at appropriate centers, such as universities.

Semanario emphasizes that joint committees would supplement, not replace, OSHA's normal inspections. Government inspectors would monitor the worksite programs, advise the committees on technical issues, and adjudicate disputes when labor-management cooperation breaks down. But she believes that workers and supervisors on-site can deal with hazards more easily—and more effectively—than can an OSHA inspector on a quick tour.

As precedents, proponents cite both Sweden and some Canadian provinces, where joint committees are required by law. And in California, the state and federal OSHAs and several construction firms cooperated in an experiment with joint committees at several large building sites. According to Joseph Rees, a political scientist from the University of North Carolina at Chapel Hill, in almost every case, overall injury rates at the test projects were one-quarter to one-half those at comparable sites.



With this exhaust system, workers who make automobile clutches are exposed to less asbestos. Joint labor and management committees might suggest other such ways to improve the poor U.S. record on occupational health and safety.

Common Ground

Health and safety issues elicit strong union and business views—views that are usually in sharp conflict. But joint committees are designed to increase common ground. Chuck Bailey, education director of the Washington State Labor Council, explains that most problems, such as a loose handrail, are straightforward and easy to address once the two sides look at the matter together. He says that relations in the joint committees at larger workplaces "seem to be very non-adversarial."

Nevertheless, in both California and New Jersey, the business community generally opposes joint-committee laws. Jeff McGuiness, president of the management-oriented Labor Policy Association in Washington, D.C., says firms worry that the committees would provide a tool for labor organizing in non-union settings. "Once you have five people dictating their views to management, you move into other issues," McGuiness says.

Opponents of the idea think it would be better for firms to start joint committees voluntarily through collective bargaining. According to McGuiness, "If an employer and union choose to set up a committee, then that's fine. The big concern is that the federal government is mandating a committee."

In fact, advocates consider GM's contract-mandated joint-committee structure a model. At GM, plant committee members work on safety and health full-time. They attend annual training provided by the auto giant and can take courses and travel to national meetings year-round. The committees are responsible for conducting weekly worksite inspections and spot-checks, as well as for resolving complaints. To track occupational injuries and illnesses, GM has installed a computer system, and each local committee has a personal computer and modem, allowing access to the data and analyses.

But Semanario points out that one reason the GM system is effective is that workers there have the UAW to pressure their employer to support the committees. Since relatively few workplaces have strong unions, she says, joint-committee legislation might be needed to raise the U.S. health and safety record out of last place. ■

MARK FEINBERG is a Boston-based free-lance writer.

PHOTO: EARL DOTTER

Fast-Track Grants

The scientific equivalent of the Good Housekeeping seal of approval, peer review is touted as the major quality-control mechanism for funding. Since World War II, it has played an important role in determining how research budgets are spent. But to speed up the award of certain grants, a recently inaugurated National Science Foundation (NSF) program does away with peer review altogether.

Peer review is not without its critics. Among a range of other complaints, a 1986 NSF survey of nearly 10,000 scientists showed that two-thirds thought "NSF is not likely to fund high-risk exploratory research because the likelihood of obtaining favorable reviews is slim."

In an effort to promote just this sort of high-risk research, in 1986 Nam Suh, then assistant director for engineering programs at NSF, launched an experimental program dubbed Expedited Awards for Novel Research. "The prevailing culture at NSF encouraged people to submit proposals with piles of references on topics that had already been studied a great deal," says Suh, who teaches mechanical engineering at MIT. "We did not have a good mechanism by which we could encourage people to come to NSF with really novel ideas."

Suh explains that researchers face several obstacles in requesting funds for exploratory work. Most NSF grant applications take a long time to prepare, evaluate, and process. Also, "with a really hot idea there often isn't much to write about initially." His answer was "a mechanism so people could get small amounts of money quickly without being subject to traditional review."

Suh gave engineering program managers authority to use 5 percent of their budgets to award up to $30,000 based on just a brief letter and phone call from the researcher. The idea balanced two economic realities. "With the small amount of money, relatively, that NSF can give out, we cannot really take care of all research needs," he says. "On the other hand, we have sufficient amounts of money to stimulate more creative and innovative research by playing a catalytic role."

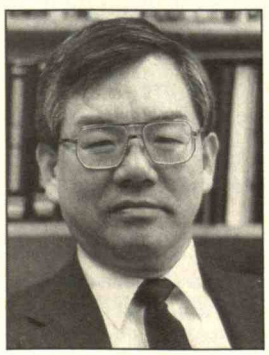
A new NSF program speeds up grant-making. Many early beneficiaries are looking at the aftermath of Hurricane Hugo, which devastated South Carolina's coast.

In the spring of 1989, an NSF panel evaluated the pilot program and recommended implementing it foundation wide, with the maximum nonrenewable grant raised to $50,000. Echoing Suh's intent, the panel concluded, "The best and ultimate result of the use of this mechanism would be to enhance risk-taking by proposers, by program managers, and by reviewers." The panel sought to encourage proposals that address "untested and novel ideas, ventures into emerging research areas, new expertise and approaches to 'old' topics, [and] new multi-disciplinary work."

By October, the renamed Small Grants for Exploratory Research (SGER) program was under way. Of 323 proposals received in the first six months, 102 had received funding as of this May, 52 had been declined, and the rest were pending, reports Jim McCullough, director of program evaluation at NSF. One-third of the awards focused either on the Loma Prieta earthquake that shook the San Francisco Bay area last fall or on the aftermath of Hurricane Hugo. "One of the purposes of the program," McCullough notes, "is very clearly to accommodate natural events when researchers have to react quickly." He stresses that it will take two or three years to really understand how the program is being used and by whom, but he does observe that the early proposals include many first-time applicants, even though SGER isn't explicitly targeted that way.

Innovation or Second-Rate?

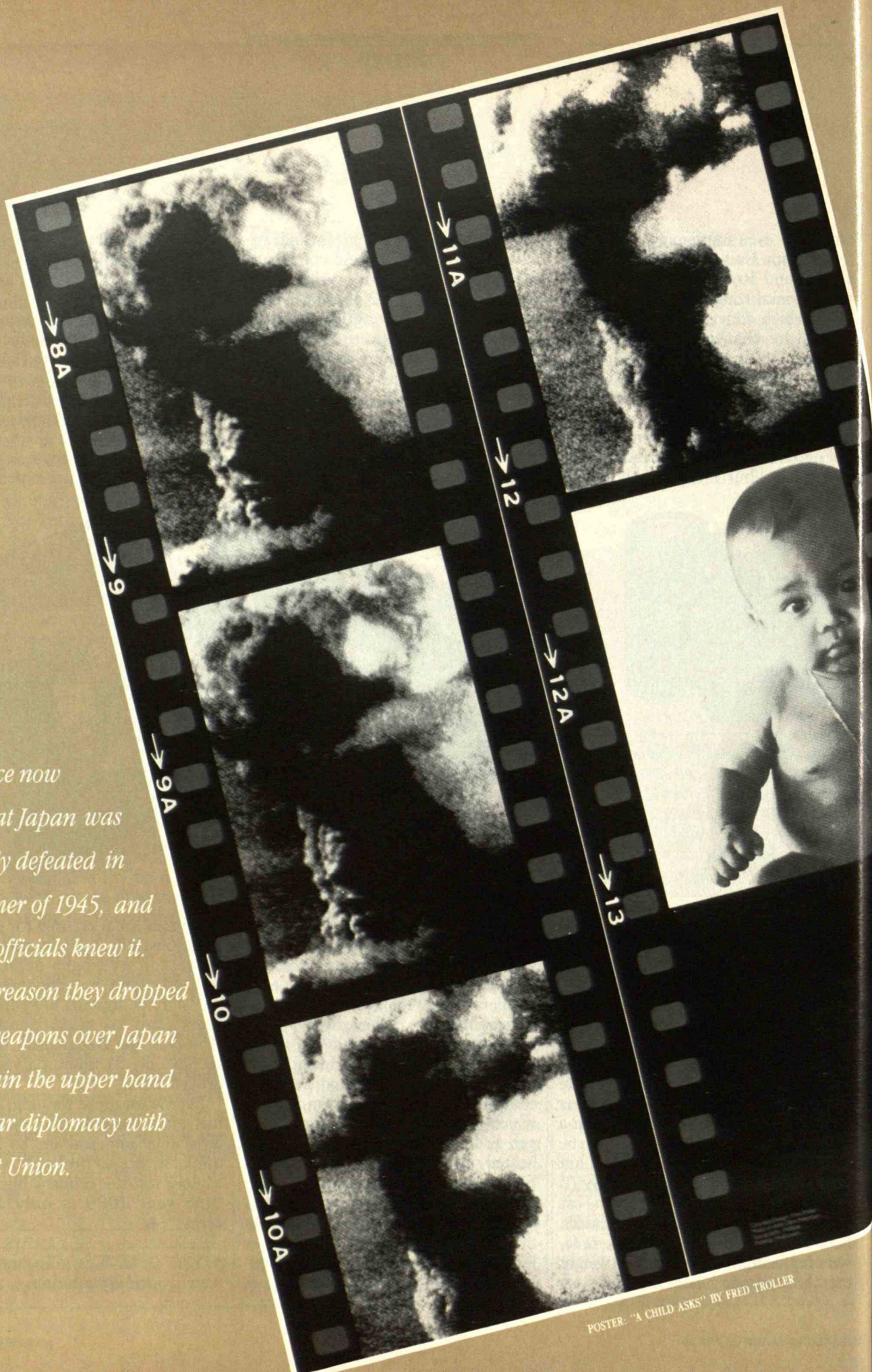
Among SGER's fans is William Carey, former executive officer of the American Association for the Advancement of Science. He thinks it "will make for a much livelier, healthier government-



Nam Suh says he initiated the Expedited Awards Program to "encourage people to come to NSF with really novel ideas."

PHOTOS: REUTERS/BETTMANN NEWSPHOTOS; EDWARD MCCLUNEY

Evidence now shows that Japan was essentially defeated in the summer of 1945, and top U.S. officials knew it. A major reason they dropped atomic weapons over Japan was to gain the upper hand in postwar diplomacy with the Soviet Union.



POSTER: "A CHILD ASKS" BY FRED TROLLER

Why the United States Dropped the Bomb

Ask the average person why the United States exploded the atomic bomb over Hiroshima and Nagasaki 45 years ago and the answer will almost always be straightforward: "To save thousands of lives by making an invasion unnecessary at the end of World War II." ABC's Ted Koppel expressed such a view in a special "Nightline" broadcast a few years ago: "What happened over Japan...was a human tragedy.... But what was planned to take place in the war between Japan and the United States would almost certainly have been an even greater tragedy."

The only problem with this morally comforting explanation is that it is now known to be false. Consider this statement: "The consensus among scholars is that the bomb was not needed to avoid an invasion of Japan.... It is clear that alternatives to the bomb existed and that Truman and his advisers knew it." The writer is not a radical revisionist but rather J. Samuel Walker, chief historian of the U.S. Nuclear Regulatory Commission.

By Gar Alperovitz

Nor is this a personal opinion: Walker is summing up the weight of modern historical studies in the respected journal *Diplomatic History.*

Scholarly judgment has shifted with the discovery of a wide range of previously unavailable documents, diaries, and private journals. In particular, as University of Illinois historian Robert Messer has written, the personal diaries of President Harry Truman have been "devastating" to the traditional argument that detonating the bomb was the only way to avoid a U.S. invasion.

The conclusions of Walker and Messer echo the judgment of the official U.S. Strategic Bombing Survey, which assessed the issue in 1946: "Certainly prior to 31 December 1945, and in all probability prior to 1 November 1945, Japan would have surrendered even if the atomic bombs had not been dropped, even if Russia had not entered the war, and even if no invasion had been planned or contemplated."

The bare chronology of events in 1945 itself raises questions about U.S. motives for dropping the bomb. Germany surrendered on May 8, and the Allied powers knew that Japan's situation was deteriorating rapidly. At the Yalta conference of Allied leaders in February, Stalin had agreed to declare war on Japan three months after the defeat of Germany—roughly August 8. The United States originally sought Soviet support for an invasion of Japan, but by late summer the shock of a Russian declaration of war seemed likely to end the war without a U.S. offensive.

The *Enola Gay* dropped its world-shattering cargo over Hiroshima on August 6. On August 8, the Soviet Union informed Japan it was entering the war. The second atomic weapon exploded over Nagasaki on August 9. The first U.S. landing on Japan was still another three months off, and a full invasion was not expected to take place—even on paper—until the spring of 1946.

Nobel Prize-winning British physicist P.M.S. Blackett pointed out as long ago as 1948 how this sequence challenged the official rationale for the bombings. Was it really the case—with three months still to go before a U.S. landing—that American and British leaders saw no alternative except detonating the bomb? The weight of evidence now strongly suggests that a major reason U.S. civilian leaders took an action that cost the lives of 225,000 people, mostly civilians, was a desire to affect the postwar balance of power with the Soviet Union.

"THE JAPANESE FLEET HAS BEEN REDUCED TO PRACTICAL IMPOTENCY....ATTRITION [OF THE JAPANESE AIR FORCE] IS HEAVY AND ITS POWER FOR SUSTAINED ACTION IS DIMINISHING RAPIDLY."

GEN. DOUGLAS MACARTHUR
COMMANDER OF U.S. PACIFIC TROOPS

Japan Seeks a Way Out

President Truman's oft-quoted estimate that a U.S. invasion might have cost a million American lives is the basis for much of the conventional wisdom about why the bomb was dropped. Unfortunately, that figure has no basis in military planning records. Stanford historian Barton Bernstein has shown that the Joint War Plans Committee—a high-level advisory group to the U.S. Joint Chiefs of Staff—concluded that about 40,000 Americans would die if an assault were launched on both the island of Kyushu and, thereafter, the main Japanese home island.

But as early as mid-June 1945—and even without a Soviet attack—it appeared that the smaller Kyushu landing alone might "well prove to be the decisive operation which will terminate the war," according to the committee. U.S. Army Chief of Staff General George C. Marshall informed President Truman that casualties for the Kyushu operation were not expected to exceed 31,000 during the first and costliest month of the operation—a figure that included dead, wounded, and missing. Extrapolating from contemporary combat statistics would yield an estimate of less than 7,500 dead.

However, these deaths would occur only if such a

GAR ALPEROVITZ, author of Atomic Diplomacy: Hiroshima and Potsdam *(Simon and Schuster 1965, Viking Penguin 1985), is president of the National Center for Economic Alternatives and a fellow of the Institute for Policy Studies in Washington, D.C. He holds a doctorate from Cambridge University, England, and for the last several decades has done research on why the United States dropped the bomb.*

ALL PHOTOS FROM UPI/BETTMANN NEWSPHOTOS

landing were actually attempted, and by mid-summer 1945 that possibility had become "remote," in the judgment of a newly discovered intelligence study. Massive documentation now shows that Japan's military, economic, and political condition deteriorated dramatically from the spring of 1945 on. Even as early as April 1945, General Douglas MacArthur, commander of U.S. troops in the Pacific, reported that "the Japanese fleet has been reduced to practical impotency. The Japanese Air Force has been reduced to a line of action which involves uncoordinated, suicidal attacks against our forces.... Its attrition is heavy and its power for sustained action is diminishing rapidly."

As the situation in Japan worsened, Japanese "peace feelers" began to erupt throughout Europe. On May 12, 1945, Office of Strategic Services Director William Donovan reported to President Truman that Shunichi Kase, Japan's minister to Switzerland, wished "to help arrange for a cessation of hostilities." He believed "one of the few provisions the Japanese would insist upon would be the retention of the Emperor."

Truman received a similar report concerning Masutaro Inoue, Japan's counselor in Portugal, who, according to an Office of Strategic Services informant, "declared that actual peace terms were unimportant so long as the term 'unconditional surrender' was not employed. The Japanese, he asserted, are convinced that within a few weeks all of their wood and paper houses will be destroyed."

Though such feelers were not yet official, in mid-June Admiral William D. Leahy—who both chaired the Joint Chiefs of Staff and served as the president's chief of staff—concluded that "a surrender of Japan can be arranged with terms that can be accepted by Japan and that will make fully satisfactory provision for America's defense against future trans-Pacific aggression."

Even more important evidence of Japan's desire to end hostilities reached the White House through intercepted diplomatic cables. U.S. intelligence experts had broken Japanese codes early in the war. During the late summer, these experts learned that the emperor of Japan was secretly attempting to arrange a surrender through Russia. The emperor wished to send a personal representative, Prince Konoye, to Moscow: "The mission...was to ask the Soviet Government to take part in mediation to end the present war and to transmit the complete Japanese case in this respect....Prince Konoe [*sic*] was especially charged by His Majesty, the Em-

THE WAR WINDS DOWN

1945

FEBRUARY 4-11:
At Yalta conference, Allied leaders confirm that Russians will enter the war against Japan three months after Germany surrenders.

MAY 8:
Germany surrenders. Soviets plan to declare war against Japan August 8.

SPRING/SUMMER:
Work on atomic bomb speeds up.

JULY 16:
First test of atomic weapon at Alamogordo, N.M.

JULY 17:
At Potsdam conference, Truman, Stalin, and Churchill meet to discuss postwar control of Europe.

AUGUST 6:
Atomic bomb dropped on Hiroshima.

AUGUST 8:
Soviets declare war on Japan.

AUGUST 9:
Second bomb dropped on Nagasaki.

AUGUST 10:
Japan offers to surrender if emperor can retain his title.

NOVEMBER 1:
U.S. invasion of Japanese island of Kyushu planned to begin.

1946

SPRING:
Projected date of U.S. invasion of Japanese main islands.

"From all I have learnt about the internal state of Japan and the sense of hopelessness weighing on their people, I believe... a triple summons to Japan to surrender, coming from our three great powers, might be decisive."

British Prime Minister Winston Churchill

peror, to convey to the Soviet Government that it was exclusively the desire of His Majesty to avoid more bloodshed."

Initial approaches to Russia can be traced as far back as 1944. The emperor's personal initiative, however, was "real evidence," as Secretary of the Navy James Forrestal put it, of a determination to end the fighting. The intercepted cables also indicated that the only significant condition appeared to be an assurance that the emperor could retain his title.

Truman later acknowledged that he had generally been informed of these messages, but his personal, handwritten journal—kept secret and, so we are told, then misfiled until 1979—is particularly revealing. In it he goes so far as to characterize one crucial Japanese intercept as the "telegram from [the] Jap Emperor asking for peace."

As these cables made clear, and as several top officials advised the president, one option that appeared likely to end the war was simply to let Japan know that "unconditional surrender" did not require removing the emperor. Indeed, since the Japanese people considered the emperor a deity, U.S. and British intelligence experts argued that without such assurances, Japan would be forced to fight to save face until the very end. U.S. military leaders also believed that only if the emperor were allowed to keep his throne would anyone have enough authority to order Japanese soldiers to put down their arms.

It is important to understand that a variety of documents, including the diaries of Secretary of War Henry L. Stimson and the papers of Acting Secretary of State Joseph C. Grew, show that President Truman had no fundamental objection to offering assurances to the emperor: he made this quite clear to both men at different points during the summer. And, of course, Truman ultimately did allow the emperor to remain: Japan has an emperor to this day.

The president chose to wait, however, until after using the atomic bomb before providing the assurances Japan sought. One common interpretation is that he feared domestic political opponents would criticize him for being "soft" on the Japanese. He may have hoped the bomb would make even small changes in the surrender terms unnecessary. But by July 1945 the choice was clearly no longer the simple one of mounting an invasion or relying on the devastating power of the new weapon.

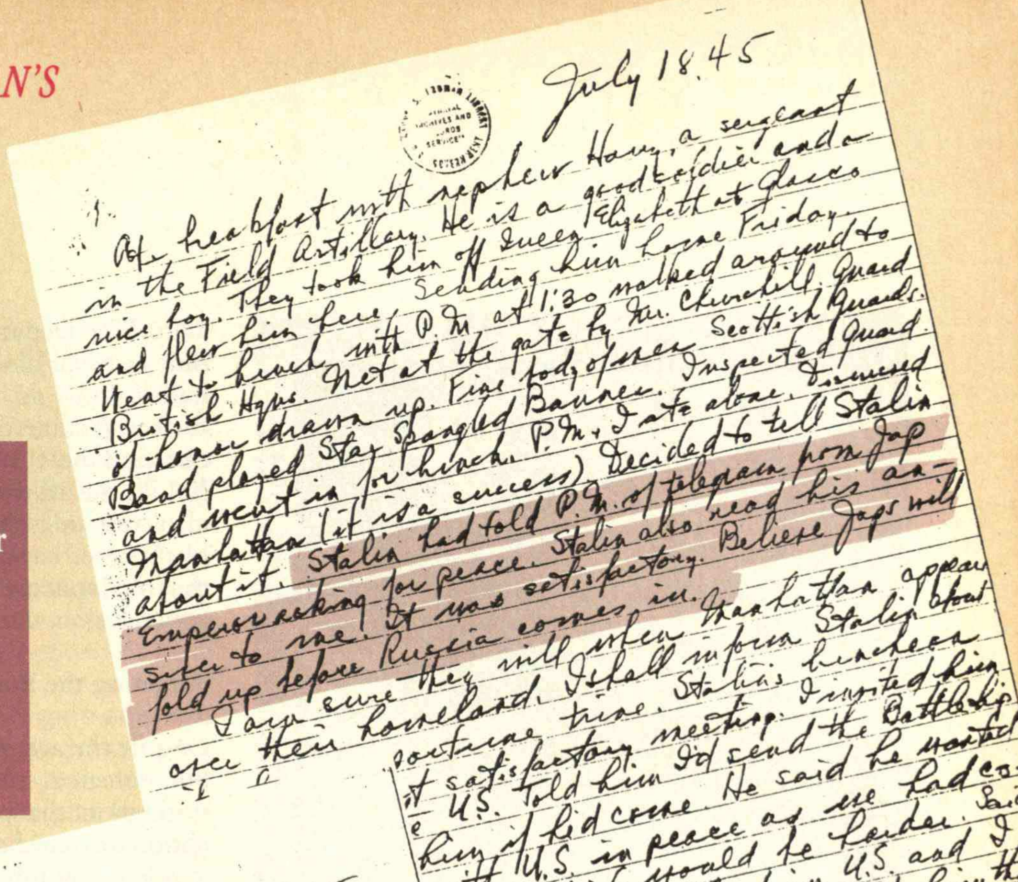
The Soviets Mobilize

Not only was Japan known to be on the verge of surrender, but an attack by the massive Red Army would clearly be disastrous, especially since Germany's capitulation had left Japan isolated. Indeed, the position of the "war party" within the Japanese Cabinet rested heavily on keeping the Soviet Union neutral.

This is an area where new evidence is particularly important. Prime Minister Churchill argued as early as September 1944 that even a public statement that Russia was about to enter the war would have enormous impact: "From all I have learnt about the internal state of Japan and the sense of hopelessness weighing on their people, I believe it might well be that once the Nazis are shattered a triple summons to Japan to surrender, coming from our three Great Powers, might be decisive."

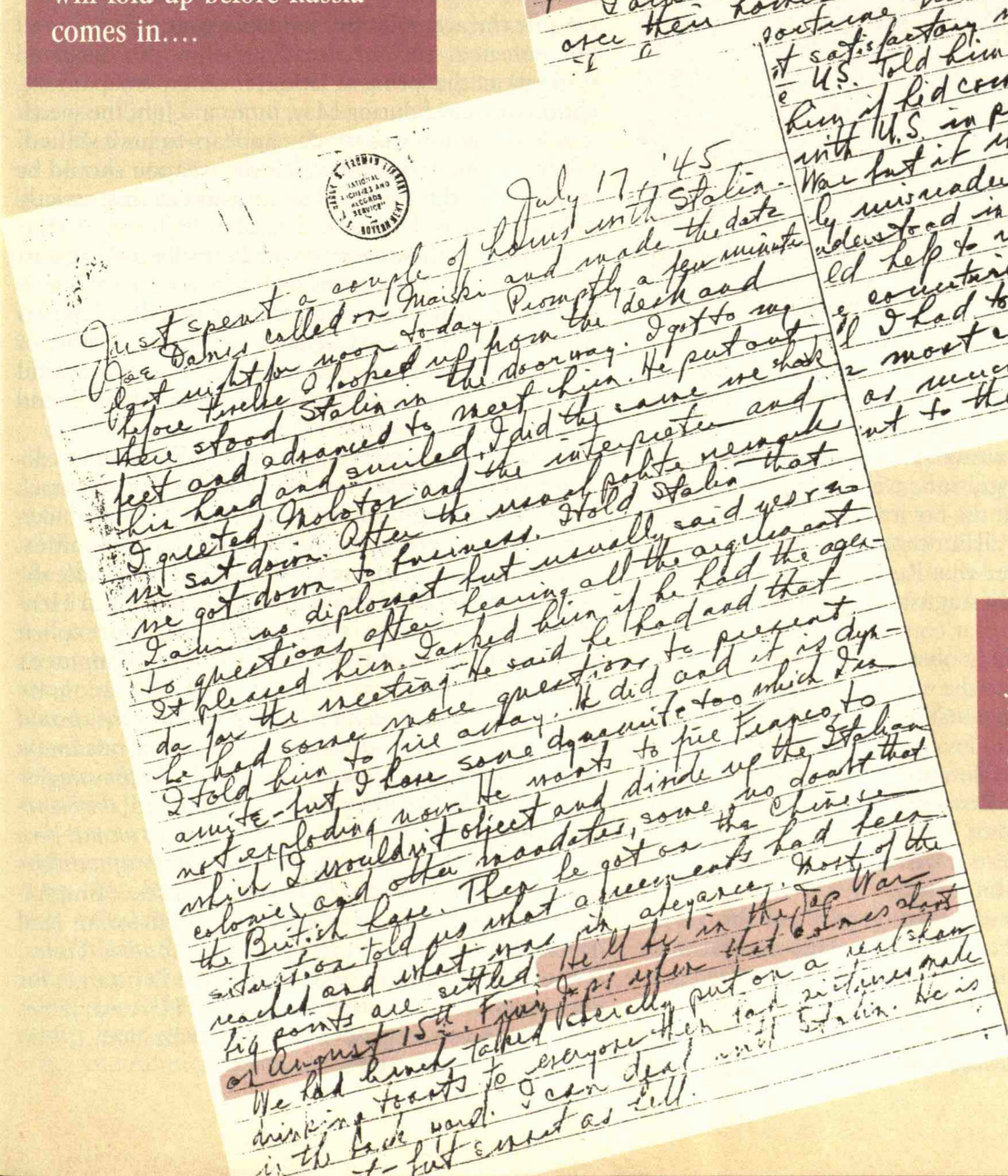
Repeated U.S. intelligence studies also judged as early as mid-April 1945 that "the entry of the U.S.S.R. into the war would... convince most Japanese at once of the inevitability of complete defeat." In mid-June 1945, General Marshall advised President Truman directly that the impact of the expected Soviet declaration of war "on the already hopeless Japanese" might well "lever" them into capitulation immediately or shortly thereafter "if" the United States landed in Japan. A month later—with still more information in hand—Britain's General Sir Hastings Ismay summarized joint American-British intelligence conclusions for Prime Minister Churchill, saying: "[W]hen Russia came into

FROM PRESIDENT TRUMAN'S PERSONAL JOURNAL JULY 1945:



July 18, '45

Ate breakfast with nephew Harry, a sergeant in the Field Artillery. He is a good soldier and a nice boy. They took him off Queen Elizabeth at Glasco and flew him here. Sending him home Friday. Went to lunch with P.M. at 1:30 walked around to British Hqrs. Met at the gate by Mr. Churchill. Guard of honor drawn up. Fine body of men Scottish Guards. Band played Stay Spangled Banner. Inspected Guard and went in for lunch. P.M. & I ate alone. Discussed Manhattan (it is a success). Decided to tell Stalin about it. Stalin had told P.M. of telegram from Jap Emperor asking for peace. Stalin also read his answer to me. It was satisfactory. Believe Japs will fold up before Russia comes in. I am sure they will when Manhattan appears over their homeland. I shall inform Stalin about it at an opportune time. Stalin's luncheon was a most satisfactory meeting. I invited him to come to the U.S. Told him I'd send the Battleship ... if he'd come. He said he wanted to co... with U.S. in peace as we had co... War but it would be harder. Said ... misunderstood in U.S. and I ... misunderstood in Russia. I told him th... ld help to remedy that situatio... countries and that I intend... I had to do my part at hom... a most cordial smile and sa... as much in Russia. ...nt to the conference and ...



July 17, '45

Just spent a couple of hours with Stalin. Joe Davies called on Maiski and made the date last night for noon today. Promptly a few minutes before twelve I looked up from the desk and there stood Stalin in the doorway. I got to my feet and advanced to meet him. He put out his hand and smiled. I did the same, we shook, I greeted Molotov and the interpreter and we sat down. After the usual polite remarks we got down to business. I told Stalin that I am no diplomat but usually said yes & no to questions after hearing all the argument. It pleased him. I asked him if he had the agenda for the meeting. He said he had and that he had some more questions to present. I told him to fire away. He did and it is dynamite—but I have some dynamite too which I'm not exploding now. He wants to fire Franco, to which I wouldn't object and divide up the Italian colonies and other mandates, some no doubt that the British have. Then he got on the Chinese situation told us what agreements had been reached and what was in abeyance. Most of the big points are settled. He'll be in the Jap War on August 15th. Fini Japs when that comes about. We had lunch talked socially put on a real show drinking toasts to everyone then had pictures made in the back yard. I can deal with Stalin. He is ... —but smart as hell.

.... Stalin had told P.M. of telegram from Jap Emperor asking for peace. Stalin also read his answer to me. It was satisfactory. Believe Japs will fold up before Russia comes in....

.... He'll be in the Jap War on August 15th. Fini Japs when that comes about....

ATOMIC "WEAPONS MIGHT FIRST BE USED AGAINST STRAIGHT MILITARY OBJECTIVES... AND THEN IF NO COMPLETE RESULT WAS DERIVED... WE OUGHT TO DESIGNATE A NUMBER OF LARGE MANUFACTURING AREAS FROM WHICH PEOPLE WOULD BE WARNED TO LEAVE."

GEN. GEORGE C. MARSHALL
U.S. ARMY CHIEF OF STAFF

the war against Japan, the Japanese would probably wish to get out on almost any terms short of the dethronement of the Emperor."

Truman's private journal, along with his letters, also illuminates his recognition, well before the atomic bomb was used, that the Soviet declaration of war—on its own—seemed all but certain to end the fighting. After Stalin confirmed that Russia would declare war against Japan in early August, Truman privately noted: "Fini Japs when that comes about." And writing to his wife, the president observed that with the Soviet declaration, "We'll end the war a year sooner now, and think of the kids who won't be killed!" (Military planners advised that if an invasion were undertaken, the war's likely maximum duration would be about a year.) So important did the Russian declaration seem before the first atomic test that Truman told several people it was his main reason for traveling to Potsdam, Germany, to meet with Stalin in July.

Since the U.S. bombings of Japan and the Soviet declaration of war occurred within days of each other, and since Japan formally surrendered only after Truman acknowledged the role of the emperor, historians continue to debate precisely how much weight to accord each factor in ending the conflict. But a top-secret 1946 War Department intelligence study discovered only last year bluntly concludes that the atomic bomb had little to do with Japan's decision to surrender. Rather, it states that the Soviet Union's entry was unquestionably the decisive factor that ended World War II. Like the official Strategic Bombing Survey, the study also concludes that a large-scale U.S. invasion would likely never have taken place: it is "almost a certainty that the Japanese would have capitulated upon the entry of Russia into the war."

Targeting the Bomb

Despite the accumulating evidence that Japan was all but defeated, plans to ready the bomb continued throughout the spring of 1945. However, as Japan's situation worsened during May, June, and July, the specific role the bomb was to play appears to have shifted. Initially some U.S. leaders felt the weapon should be employed in the course of an invasion against strictly military targets. Even as late as May 29, General Marshall thought "these weapons might first be used against straight military objectives such as a large naval installation and then if no complete result was derived from the effect of that,...we ought to designate a number of large manufacturing areas from which people would be warned to leave—telling the Japanese that we intend to destroy such centers."

By early June, however, Japan's condition had so deteriorated that a psychological shock—not an attack to destroy "straight military objectives"—seemed likely to produce surrender. But the Interim Committee, a high-level group formed to decide how to handle the new technology and chaired by Secretary of War Henry L. Stimson, rejected the option of giving an explicit warning to civilians. According to the committee's records, "*The Secretary expressed the conclusion, on which there was general agreement, that...we should seek to make a profound psychological impression on as many of the inhabitants as possible. At the suggestion of Dr. Conant* [the president of Harvard] *the Secretary agreed that the most desirable target would be a vital war plant employing a large number of workers and closely surrounded by workers houses.*" [Emphasis in original.] And the conservative historian Paul Johnson bitterly comments in his *Modern Times,* "When the time came to determine the first target for the atomic bomb, it was the President of Harvard, James Conant representing the interests of civilization..., who made the decisive suggestion."

Various scientists, upset that the bombing would proceed even though Germany had been defeated and Japan had been reduced to dire straits, attempted to head it off. New research has also given us a clearer picture of the many ways their efforts were blocked. Peter Wyden, for instance, describes in his *Day One* how J. Robert Oppenheimer deftly sidetracked Chicago scientists opposed to using the atomic weapon. General Leslie Groves, the military leader of the Manhattan Project, and other top officials also simply delayed a petition to the president registering scientists' opposition until it was too late.

Wesleyan political scientist Leon V. Sigal has shown how the dissident scientists' challenges prompted a change in the fundamental role and composition of the Interim Committee. Its initial task was to plan for postwar handling of atomic weapons and atomic energy. But, Sigal suggests, "Consideration by the committee... of how to use the bomb against Japan was part of a bureaucratic strategy of senior War Department [and other] officials with organization interests in dropping the bomb on Japan's cities." He concludes that "the committee was... a blocking maneuver to blunt the dissidents by preventing their options and arguments from reaching President Truman and by getting other scientists to endorse the option already chosen by the Target Committee."

Several high-level military leaders, when told of the decision to drop the bomb, were deeply offended. General Dwight D. Eisenhower, commander of U.S. forces in Europe, reported this reaction after Secretary of War Henry L. Stimson informed him in mid-July of the plan: "During his recitation of the relevant facts, I had been conscious of a feeling of depression and so I voiced to him my grave misgivings, first on the basis of my belief that Japan was already defeated and that dropping the bomb was completely unnecessary, and secondly because I thought that our country should avoid shocking world opinion by the use of a weapon whose employment was, I thought, no longer mandatory as a measure to save American lives." Eisenhower's assessment was blunt: "Japan was at that very moment seeking some way to surrender with a minimum loss of 'face'.... It wasn't necessary to hit them with that awful thing."

Similarly, the reaction of Britain's General Ismay to attacking Japanese cities with the new weapon was "revulsion." He added, "For some time past it had been firmly fixed in my mind that the Japanese were tottering." And Admiral Leahy, the highest U.S. military official, minced few words in recounting his view of this period. The "Japanese were already defeated and ready to surrender.... The use of this barbarous weapon against Hiroshima and Nagasaki was of no material assistance in our war against Japan.... [I]n being the first to use it, we...adopted an ethical standard common to the barbarians of the Dark Ages. I was not taught to make war in that fashion, and wars cannot be won by destroying women and children."

"In being the first to use [the bomb], we...adopted an ethical standard common to barbarians of the Dark Ages. I was not taught to make war in that fashion, and wars cannot be won by destroying women and children."

Adm. William Leahy
Chair of Joint Chiefs of Staff

The Bomb and the Soviets

Historians are divided in attempting to explain why, in the face of the evidence we now have, U.S. leaders chose to use the atomic bomb. But a number of experts agree that a once-controversial factor—the U.S. hope of strengthening the West's hand against the Soviet Union—played a significant role.

The clearest evidence points to a strong U.S. desire to end the war before the Russians attacked Japan. Truman and his advisors knew that the Red Army would engage the Japanese in Manchuria and North China, a move that would put them in a position to dominate the area after the war. Although there was plenty of time to test Japan's reaction to the Soviet declaration of war,

"IT MAY BE NECESSARY TO HAVE IT OUT WITH RUSSIA ON HER RELATIONS TO... NORTH CHINA, AND ALSO THE RELATIONS OF CHINA TO US. OVER ANY SUCH TANGLED WEAVE OF PROBLEMS THE [ATOMIC BOMB] SECRET WOULD BE DOMINANT....IT SEEMS A TERRIBLE THING TO GAMBLE WITH SUCH BIG STAKES... WITHOUT HAVING YOUR MASTER CARD IN YOUR HAND."

SECRETARY OF WAR
HENRY L. STIMSON

"I DON'T THINK THERE WAS A TIME WHERE WE WORKED HARDER AT THE SPEED-UP THAN IN THE PERIOD AFTER THE GERMAN SURRENDER."

J. ROBERT OPPENHEIMER
HEAD OF THE
MANHATTAN PROJECT

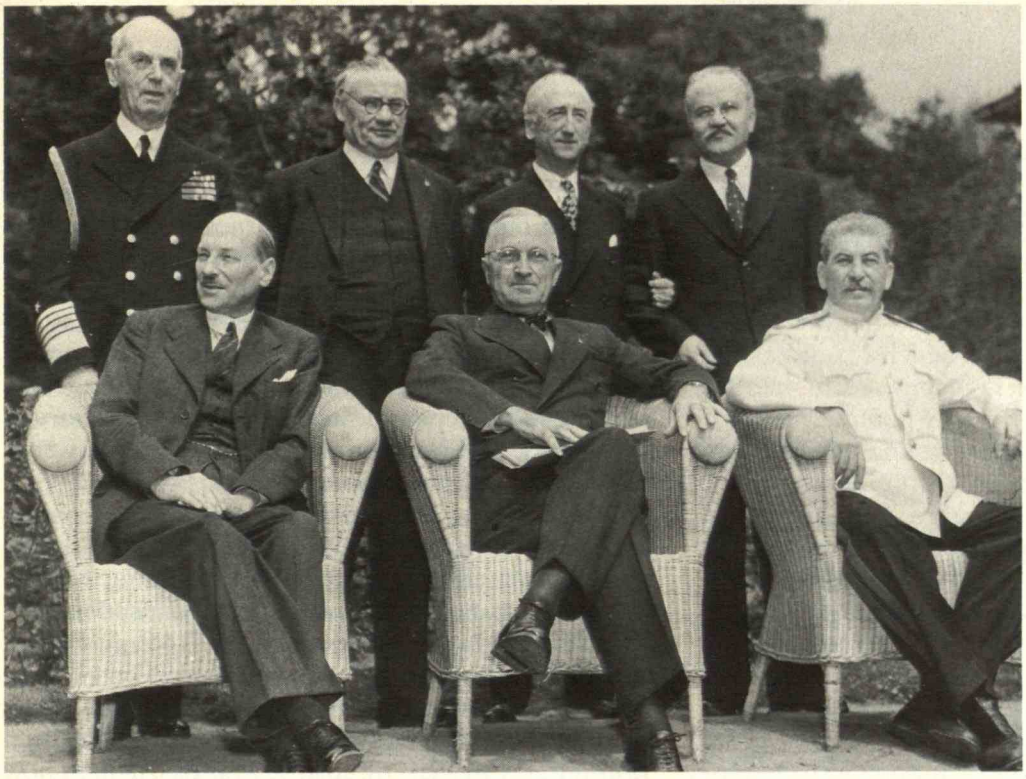
once U.S. and British officials knew the atomic bomb actually worked they desperately wanted to end the fighting before the Red Army crossed into Manchurian and Chinese territory.

For example, the private journal of Walter Brown, personal assistant to Secretary of State James F. Byrnes, notes that Byrnes was "hoping for time, believing that after [the] atomic bomb Japan will surrender and Russia will not get in so much on the kill, thereby being in a position to press claims against China." Prime Minister Churchill also observed on July 23, 1945, "It is quite clear that the United States do not at the present time desire Russian participation in the war against Japan." And the diary of Navy Secretary James V. Forrestal records that Secretary of State Byrnes was now "most anxious to get the Japanese affair over with before the Russians got in."

McGeorge Bundy—who co-authored Secretary of War Stimson's postwar defense of the bombing—also recently observed in his *Danger and Survival* that "using the Soviet plan to attack as a means of inducing Japanese surrender" was rejected mainly because of political concerns about the future balance of power in Asia.

Even scientists in the field got an inkling that the atmosphere had changed with the defeat of Germany. Oppenheimer, for instance, later testified: "I don't think there was a time where we worked harder at the speed-up than in the period after the German surrender." Physicist Philip Morrison noted that "I can testify personally that a date near August tenth was a mysterious final date which we, who had the daily technical job of readying the bomb, had to meet at whatever cost in risk or money or good development policy." And Albert Einstein publicly voiced his suspicion that the bombing occurred because of "a desire to end the war in the Pacific by any means before Russia's participation. I am sure that if President Roosevelt had still been there, none of that would have been possible. He would have forbidden such an act."

Modern documentary discoveries also indicate that U.S. officials expected the bomb to provide a second political advantage. From April 1945 on, they calculated that the weapon would enormously bolster negotiations with the Soviets over the fate of postwar Europe as well as Asia. The Red Army had moved into Eastern Europe while defeating Germany, and the Allies were struggling over the control and composition of the government in each country. Churchill, Stalin, and Truman had agreed to meet in Potsdam, Germany, to discuss these and other European matters.



Leaders of the Big Three gather in Potsdam, Germany, on July 17, 1945—one day after the first atomic explosion at Alamogordo, N.Mex.—to discuss plans for postwar Europe. Front: British Prime Minister Clement Attlee (Churchill's successor), Harry S. Truman, and Josef Stalin. Truman delayed the Potsdam meeting until after the atomic test.

The general assumption that the weapon would strengthen the overall U.S. and British diplomatic position can be traced to the early Roosevelt years. When Roosevelt died, the new president initially received a full briefing on the atomic bomb mainly because of its likely impact on diplomacy, not its role vis-à-vis Japan. In late April, for example, in the midst of an explosive fight with Stalin over the composition of the postwar Polish government, Secretary of War Stimson urged discussion of the bomb because (as he told Truman) it had "such a bearing on our present foreign relations and...such an important effect upon all my thinking in this field."

Stimson's diaries show that although he regarded the atomic bomb as the "master card" of diplomacy toward Russia, he believed sparring with the Soviet Union in the early spring, before the weapon was demonstrated, would be counterproductive. After a mid-May meeting on Far Eastern issues, for instance, Stimson observed that "the questions cut very deep and...[were] powerfully connected with our success with S-1 [the atomic bomb]." Two days later he noted that "it may be necessary to have it out with Russia on her relations to Manchuria and Port Arthur and various other parts of North China, and also the relations of China to us. Over any such tangled weave of problems the [atomic bomb] secret would be dominant and yet we will not know until after that time, probably...whether this is a weapon in our hands or not. We think it will be shortly afterwards, but it seems a terrible thing to gamble with such big stakes in diplomacy without having your master card in your hand."

Stimson therefore urged delaying diplomatic fights with Russia, as he indicated in another mid-May diary entry after a conversation with Assistant Secretary of War John J. McCloy: "[T]he time now and the method now to deal with Russia was to keep our mouths shut and let our actions speak for words. The Russians will understand them better than anything else. It is a case where we have got to regain the lead and perhaps do it in a pretty rough and realistic way. [T]his [is] a place where we really held all the cards. I called it a royal straight flush and we mustn't be a fool about the way we play it. They can't get along without our help and industries and we have coming into action a weapon which will be unique.

"Now the thing is not to get into unnecessary quarrels by talking too much and not to indicate any weakness by talking too much; let our actions speak for themselves."

Stimson's files and other documents show that President Truman had come to similar conclusions. Quite specifically—and against the advice of Churchill (who wanted an early meeting with Stalin before American troops were withdrawn from Europe)—the president postponed his only diplomatic encounter with the Soviet leader because he first wanted to know for certain that the still untested atomic bomb actually

worked. "If it explodes, as I think it will," he told a close associate, "I'll certainly have a hammer on those boys." After a May 1945 meeting with Truman, Ambassador Joseph E. Davies' diaries record that "to my surprise, he said he did not want it [the heads-of-government meeting] until July. The reason which I could assign was that he had his budget on his hands.... 'But,' he said, 'I have another reason...which I have not told anybody.' He told me of the atomic bomb. The final test had been set for June, but now had been postponed until July. I was startled, shocked and amazed." (After Truman told Stimson of his overall strategy toward the Potsdam meeting, the secretary of war agreed: "We shall probably hold more cards in our hands later than now.")

Strong evidence now shows that Secretary of State James F. Byrnes, an influential former Supreme Court Justice, played a central role in determining Truman's view of the bomb's utility. Byrnes had been one of Truman's mentors when the young unknown from Missouri first came to the Senate. By choosing Byrnes as his personal representative on the Interim Committee, Truman arranged to secure primary counsel on both foreign policy and the atomic bomb from a single trusted advisor. (If Truman had been interested in a strictly military appraisal of the bomb, of course, he would have relied primarily on the War Department for advice.)

There is not much doubt about Byrnes' consistently hardline viewpoint. In one of their very first meetings, Byrnes told Truman that "in his belief the atomic bomb might well put us in a position to dictate our own terms at the end of the war." At the end of May, Byrnes met at White House request with atomic scientist Leo Szilard. Szilard found that "Mr. Byrnes did not argue that it was necessary to use the bomb against the cities of Japan in order to win the war.... Mr. Byrnes's...view [was] that our possessing and demonstrating the bomb would make Russia more manageable in Europe.... Russian troops had moved into Hungary and Rumania; Byrnes thought...that Russia might be more manageable if impressed by American military might."

In May of 1945, Byrnes also intervened forcefully to oppose General Marshall and others on the Interim Committee who suggested that the Russians be told of the bomb's existence before it was used. Marshall further urged that Russian scientists be invited to witness the test—a proposal also rejected. In general, Byrnes, representing the president, took a very tough line against any attempt to seek international control of the new weapon. He was intensely interested in how long the U.S. nuclear monopoly would last, pressing scientists on the question in meetings of the committee's scientific panel on May 31. Byrnes also repeatedly stressed the need to accelerate research to stay ahead.

After discussions at Potsdam, Ambassador Davies recorded in his diary that "Byrnes' attitude that the atomic bomb assured ultimate success in negotiations disturbed me.... I told him the threat wouldn't work, and might do irreparable harm." Assistant Secretary of War John J. McCloy, too, met with Byrnes a few weeks after Hiroshima and reported to Stimson that Byrnes, about to depart for a meeting with Soviet Foreign Minister Vyacheslav Molotov, "was quite radically opposed" to any effort to reach an understanding with the Russians to control nuclear weapons. Stimson himself talked with Byrnes on September 4, 1945, and noted that "Jim Byrnes had not yet gone abroad and I had a very good talk with him afterwards sitting in the White House hall.... I took up the question which I had been working at with McCloy up in St. Huberts, namely how to handle Russia with the big bomb. I found that Byrnes was very much against any attempt to cooperate with Russia. His mind is full of his problems with the coming meeting of foreign ministers and he looks to having the presence of the bomb in his pocket, so to speak, as a great weapon to get through the thing."

The Bomb Works

The timing of Truman's summer strategy to delay negotiations with Stalin worked exquisitely: the first successful atomic test occurred on July 16, 1945. Truman sat down for discussions with the Soviet premier the very next day, July 17. Secretary of War Stimson's diary includes this entry after he received a full report of the test results: "[Churchill] told me that he had noticed at the meeting of the Big Three yesterday that Truman was evidently much fortified by something that had happened and that he stood up to the Russians in a most emphatic and decisive manner, telling them as to certain demands that they absolutely could not have and that the United States was entirely against them. He said 'Now I know what happened to Truman yesterday. I couldn't understand it. When he got to the meeting after having read this report he was a changed man. He told the Russians just where they got on and off and generally bossed the whole meeting.'"

A July 22, 1945, entry in the diary of Field Marshall Alan Brooke, chief of the British imperial general staff, further describes Churchill's reaction—and provides more indirect evidence of the atomic bomb's impact on

American attitudes: "[The Prime Minister]...had absorbed all the minor American exaggerations and, as a result, was completely carried away.... We now had something in our hands which would redress the balance with the Russians. The secret of this explosive and the power to use it would completely alter the diplomatic equilibrium which was adrift since the defeat of Germany. Now we had a new value which redressed our position (pushing out his chin and scowling); now we could say, 'If you insist on doing this or that, well...' And then where are the Russians!"

A number of historians now agree that long-term diplomatic interests—beyond a specific desire to end the war before the Red Army crossed the Manchurian border—influenced Truman, Stimson, and Byrnes, consciously or unconsciously, when they chose the bomb over other readily available ways to stop the fighting. Experts differ, of course, in the precise weight to accord this motive in the thinking of each U.S. leader, and some continue to hold that solely military factors were involved, or that the weapon's use was "inevitable" because of the technological, bureaucratic, and military momentum built up during the war. Other historians argue that because huge sums were spent developing the new weapon, political leaders found it impossible not to use it. Still others believe a roughly even mix of political-diplomatic considerations and military concerns were at work, and some writers look to bureaucratic infighting to explain the outcome. But the late Herbert Feis, a friend of Stimson's, an advisor to three secretaries of war, and a historian with impeccable connections, judged a quarter-century ago that "impressing" the Soviets almost certainly played a role in the decision to use the atomic bomb. And Yale professor Gaddis Smith sums up a growing modern view that "the decision to bomb Japan was centrally connected to Truman's confrontational approach to the Soviet Union."

In fact, some historians now believe that the atomic bomb probably even prolonged the war and cost American lives rather than saved them, since Acting Secretary of State Joseph Grew advised the president as early as May 1945 that changing the surrender terms might well halt the fighting—and since the president apparently delayed until the bomb was ready. "Many more American soldiers and Japanese of all types," Tufts University historian Martin Sherwin writes, "might have had the opportunity to grow old if Truman had accepted Grew's advice." Secretary of War Stimson, too, came subsequently to believe "that history might find

SECRETARY OF STATE "BYRNES DID NOT ARGUE THAT IT WAS NECESSARY TO USE THE BOMB AGAINST THE CITIES OF JAPAN IN ORDER TO WIN THE WAR....[HIS VIEW WAS] THAT OUR POSSESSING AND DEMONSTRATING THE BOMB WOULD MAKE RUSSIA MORE MANAGEABLE IN EUROPE."

ATOMIC SCIENTIST LEO SZILARD

"BYRNES' ATTITUDE THAT THE ATOMIC BOMB ASSURED ULTIMATE SUCCESS IN NEGOTIATIONS DISTURBED ME....I TOLD HIM THE THREAT WOULDN'T WORK, AND MIGHT DO IRREPARABLE HARM."

AMBASSADOR JOSEPH E. DAVIES

"Before the bomb was used, I would have said, yes, I was sure we could keep the peace with Russia. Now I don't know... People are frightened and disturbed all over. Everyone feels insecure again."

Gen. Dwight D. Eisenhower
Commander Of U.S. Forces In Europe

the United States, by its delay in stating its position [on surrender terms], had prolonged the war."

Atomic Stalemate

In a post-victory visit to Moscow, General Dwight Eisenhower observed that "before the atom bomb was used, I would have said, yes, I was sure we could keep the peace with Russia. Now I don't know.... People are frightened and disturbed all over. Everyone feels insecure again." At the September 1945 London Conference of Foreign Ministers, Byrnes—relying upon the atomic bomb—did, in fact, attempt to make Russia "more manageable" in such Eastern European nations as Bulgaria and Rumania. John Foster Dulles, who was present, believed the tensions that became the Cold War started at this time.

In Washington, Secretary Stimson—now profoundly troubled by Byrnes' attitude and the developing momentum of U.S. policy—undertook what is undoubtedly one of the most remarkable, if unsuccessful, reversals in American history. Acknowledging that "I was wrong" to think the U.S. should "hang onto the bomb as long as possible," Stimson came to believe this would be "by far the more dangerous course."

In a direct approach to the president, Stimson urged an immediate initiative to establish cooperative international control of the new weapon. He emphasized that the Russians were unlikely to respond if the approach were made in a public arena like the United Nations, or if it were made "after a succession of express or implied threats or near threats." The alternative, Stimson warned, would likely be "a secret armament race of a rather desperate character." He stressed: "If the atomic bomb were merely another though more devastating military weapon to be assimilated into our pattern of international relations, it would be one thing.... But I think the bomb instead constitutes merely a first step in a new control by man over the forces of nature too revolutionary and dangerous to fit into the old concepts...."

"To put the matter concisely, I consider the problem of our satisfactory relations with Russia as not merely connected with but as virtually dominated by the problem of the atomic bomb."

Forty-five years after these critical events, the full record of what happened in the summer of 1945 is still not available. We especially lack knowledge of many private discussions between Secretary Byrnes and President Truman during April, May, and June 1945, when Byrnes served as the president's personal representative on the Interim Committee. We know almost nothing about the critical planning sessions the two men held during the eight-day Atlantic crossing before the Potsdam conference and the bombing itself. Beyond this, many official documents—ranging from selected Japanese "intercepts" to specific Manhattan Project files—are still classified, and some private journals have not been made public.

We shall undoubtedly learn the full truth one day. As the Cold War winds down, there is renewed interest in the Hiroshima story—and in the profound questions Secretary Stimson and others came to understand were posed by the first use of nuclear weapons, and by the U.S. contribution to the tensions that were to dominate international relations for more than four decades. ■

Without a Trace

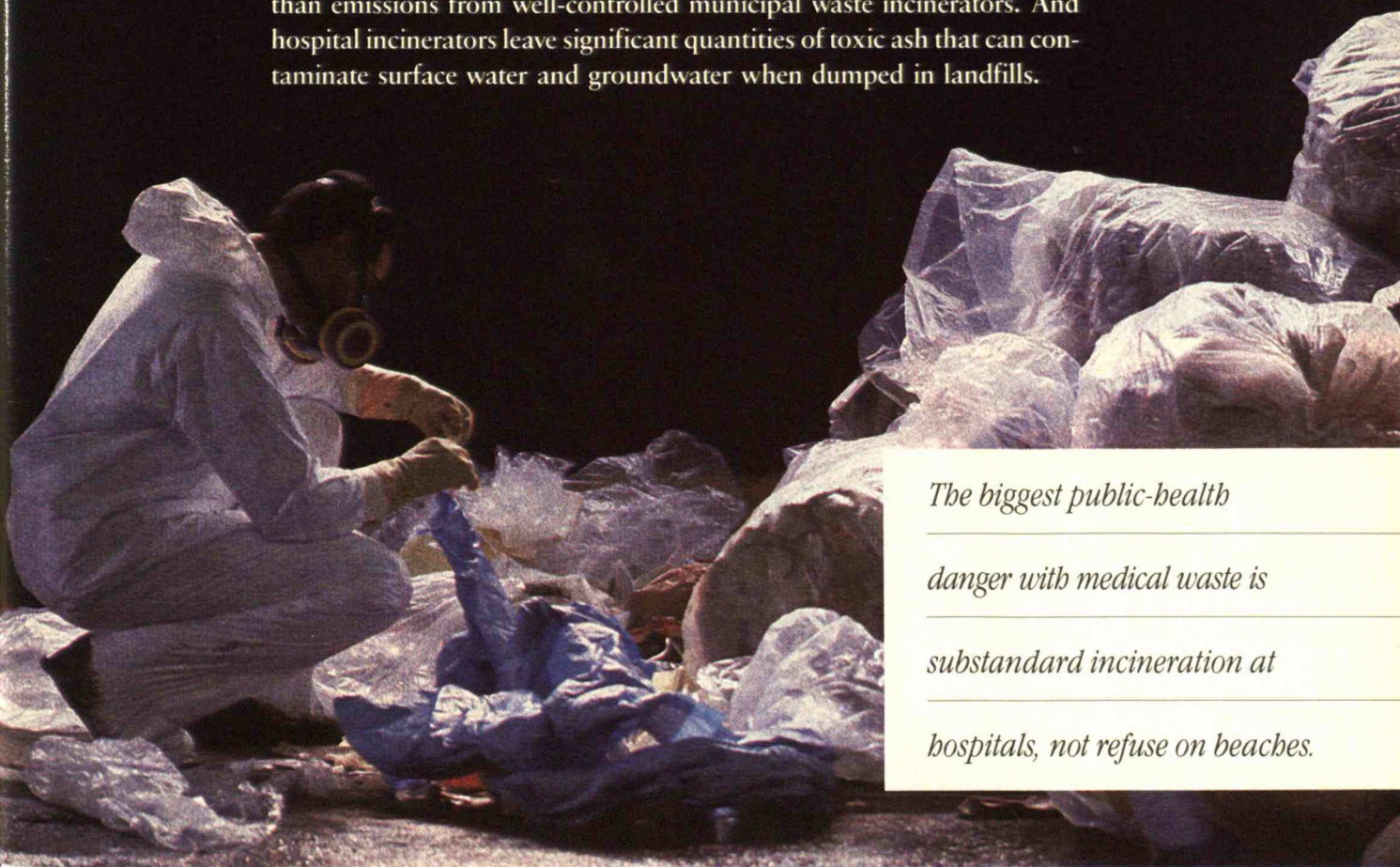
Handling Medical Waste Safely

By Allen Hershkowitz

It's summer: time again for dripping ice-cream cones, sandy bathing suits, and syringes washing up on beaches. For the past several summers, businesses in coastal areas have lost billions of dollars as people stayed away from beaches—some of them closed—that were contaminated with medical waste. Would-be beachgoers have feared that they could catch AIDS by accidentally stepping on a syringe.

In fact, the likelihood of acquiring the AIDS virus from medical waste on a beach is virtually nil. While there is a slightly greater chance—though still very small—of people being infected with a hepatitis virus, which can last about two weeks outside a host, the major public-health problem with medical waste has nothing to do with beaches.

The real danger, which has received far less notice, stems from the 6,000 substandard medical-waste incinerators at hospitals around the nation. Usually concentrated in populous urban areas, these facilities each year spew tons of toxic emissions—including dioxin, heavy metals, and acid gases—into the air at much higher rates than state-of-the-art incinerators in other countries. In fact, according to the congressional Office of Technology Assessment (OTA), air emissions of dioxin and heavy metals from hospital incinerators average 10 to 100 times more per gram of waste burned than emissions from well-controlled municipal waste incinerators. And hospital incinerators leave significant quantities of toxic ash that can contaminate surface water and groundwater when dumped in landfills.



The biggest public-health danger with medical waste is substandard incineration at hospitals, not refuse on beaches.

The U.S. could learn from Switzerland and West Germany, where little mismanagement of medical waste has been recorded.

Such a disposal system is also dangerous for those who work with it. Hospital incinerators are usually operated by undertrained janitorial staff. They may accidentally pierce themselves with needles sticking through bags of garbage, for example, or may be poisoned by shoveling lead-contaminated ash.

Given these public-health problems, and the economic problem of syringes on beaches—not to mention the mismanagement of the resources contained in medical waste—we need a much better system for handling this refuse. Two countries offer good models for an improved system of medical-waste disposal—Switzerland and West Germany. Unlike the United States, these nations, along with Sweden, have nationally consistent medical-waste procedures and have recorded little mismanagement of medical refuse in the past decade.

Tons of Medical Waste

No one knows how much medical waste is generated in the United States, but estimates for the nation's hospitals range from 500,000 to 3 million tons a year. Although the amount is minuscule compared with all U.S. waste, in 1988 the equivalent of just two bags of medical waste was enough to close dozens of beaches in the Northeast and cause $2 billion to $3 billion in losses for local businesses.

Medical waste has increased greatly during the past 30 years. In part this is because hospitals use more disposable items, which they see as more convenient. Although the use of disposable syringes is reasonable, many environmentalists question hospitals' need for disposable plates, cutlery, food trays, suture cutters, bedpans, and even linen and telephones.

Hospitals get rid of their medical waste in a variety of ways. They may discard some infectious liquid into sewage systems. Although this disposal route is legal, the country's sewage-treatment plants do not always have the capacity to handle the waste. In fact, these plants routinely discharge contaminated waste into coastal waters. As a result, dozens of northeastern beaches in 1989 had to close more than 570 times.

For most infectious waste, hospitals typically use incinerators. Perhaps two-thirds of all U.S. hospitals do this job on site. In several states, the Environmental Protection Agency (EPA) actually encourages this practice in rules issued under the 1988 Medical Waste Tracking Act. In an attempt to curb garbage on beaches in New York, New Jersey, Connecticut, Rhode Island, and Puerto Rico, the law stipulates that hospitals sending medical wastes off site must fill out a form about what

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ALLEN HERSHKOWITZ is a senior staff scientist at the Natural Resources Defense Council in New York City. He served on peer-review panels for medical-waste reports to Congress by the Office of Technology Assessment and the Centers for Disease Control's Agency for Toxic Substances and Disease Registry.

PHOTOGRAPHS: BOB SACHA

they consist of and where they go. But with on-site treatment, hospitals do not have to keep as detailed records of wastes or their ash residue.

Unfortunately, U.S. hospital incineration plants have only the most rudimentary air-pollution control technologies, if any. As of June 1990, no federal regulations existed to control the high levels of heavy metals, acid gases, and toxic organic compounds that hospital incinerators spew forth. A particular concern is plastics, which by some estimates account for 60 percent of the volume of waste burned at on-site incinerators. Most plastics contain chlorides and metallic compounds, which can produce toxic air emissions and ash when incinerated.

The problem is compounded by the number of hospital incinerators in cities. New York City, for example, has almost 60. With the peak concentration of air pollutants often greatest near emission sources, the combination of many plants is likely to cause more health problems than a single regional incinerator removed from a city. This is especially true for hospital incinerators with low stacks in areas with high precipitation.

At a minimum, adequate control of air emissions requires acid-gas scrubbers—which spray lime and water into flue gas to form harmless calcium salts—and electrostatic precipitators, which collect particles that have absorbed toxic flue gases. But this equipment costs millions of dollars—uneconomical for the small amounts of infectious waste that a hospital generates.

Virtually all medical wastes in Switzerland and West Germany go to regional incineration facilities. This system makes advanced air-pollution control technologies cost-effective. Stringent air-quality regulations in these countries make it impractical for hospitals to incinerate their medical wastes on site.

In Switzerland, the wastes go either to municipal-garbage incineration plants or to hazardous-waste facilities. Municipal plants usually receive general refuse from hospitals and infectious wastes that doctors and nurses decide can go this route after disinfection. All other medical wastes are sent to hazardous-waste treatment plants.

The state of Bavaria provides a striking example of how the West German system works. When air-pollution regulations set up 10 years ago forced about 150 on-site hospital incinerators to close, hospitals started sending their wastes to a regional facility in Munich. At a municipal solid-waste incinerator there, two furnaces suitable for hazardous wastes handle medical waste. One furnace is a backup for when the other is down for maintenance.

The operation of the infectious-waste incinerators is professional and sophisticated. Certified engineers who run the plant not only train for two months on site but usually volunteer for another two months of education that covers worker safety and air-emissions control. An association of boiler manufacturers provides some workers with two more years of schooling.

Monitors in the incinerators' control rooms aid the highly trained workers in continually measuring temperature, oxygen, and potentially dangerous chemical emissions: hydrogen chloride, hydrogen fluoride, sulfur dioxide, carbon monoxide, oxides of nitrogen, and particulates.

The sophisticated combustion and air-pollution control equipment of Munich's adjacent municipal solid-waste incinerator removes 99.7 percent of the toxic components from the medical-waste flue gases. And the hazardous-waste incinerators generate 7 to 10 percent ash by volume, less than that usually produced by municipal solid-waste incinerators and substantially less than that coming from medical-waste incinerators at U.S. hospitals. The Munich operators finally dump the ash in specially lined landfills.

As elsewhere in Germany, Bavarian hospitals are required to help plan treatment and disposal capacity. They do so by informing the cities in which they operate about how much and what types of waste they generate.

The Munich case suggests a way that the United States could phase out on-site incineration by hospitals. Regional collection and treatment facilities, including municipal-waste incinerators, should be used instead. The plants would need special feed systems to keep materials away from workers, and ought to offer worker training that includes certification programs and updates. The facilities would need comprehensive pollution-control devices and would have to undergo strict emissions and ash testing every year. And ash would need to be safely handled and disposed of in landfills outfitted with composite liners and pipes to collect leached liquids. Patient-care wastes would have to be disinfected or incinerated before they were sent to landfills. Finally, hospitals would have to inform states about the wastes they generate. Including transportation and landfill costs, such measures could add 8 to 15 cents per pound to the cost of disposing of hospital waste, which—given the uncertainty of the amount—is not known.

Another option would cost less money. For 3 to 10 cents a pound over today's costs, hospitals could send their wastes to regional facilities that autoclave the waste—disinfect it with pressured steam—and break it down by compacting it. Some 90 percent of medical waste, excluding certain hazardous and radioactive refuse, could be sent to autoclaves, which do not pollute the air. In the last couple of years, as poorly designed incineration schemes have faltered to community opposition, regional autoclave plants have looked like a more and more attractive alternative.

Mailing Medical Waste

For a regional system to work, medical waste must be

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safely transported. Today the United States has no federal statute governing the transport of medical refuse. In fact, in this country refrigerated trucks legally can and do carry food after transporting medical wastes—without first being cleaned. Medical refuse is also sometimes legally shipped through the mail.

Again, West Germany and Switzerland can serve as models. For starters, national transportation regulations there require hospitals to categorize and separate wastes for recycling, incineration, or landfill. West Germany's National Health Department has established four categories of medical waste: general (including office and cafeteria refuse), "awkward and ugly" (blood-splattered items that are not infectious), infectious, and pathological (body parts).

The Germans regulate categorization stringently. Doctors can lose their licenses if someone gets infected by waste that has been labeled safe.

After categorizing the waste, hospitals must package it safely before sending it to incinerators. In Switzerland, for instance, all infectious and pathologic waste—as well as sharp instruments such as needles and scalpels—must go into labeled, rigid plastic containers that cannot be reopened.

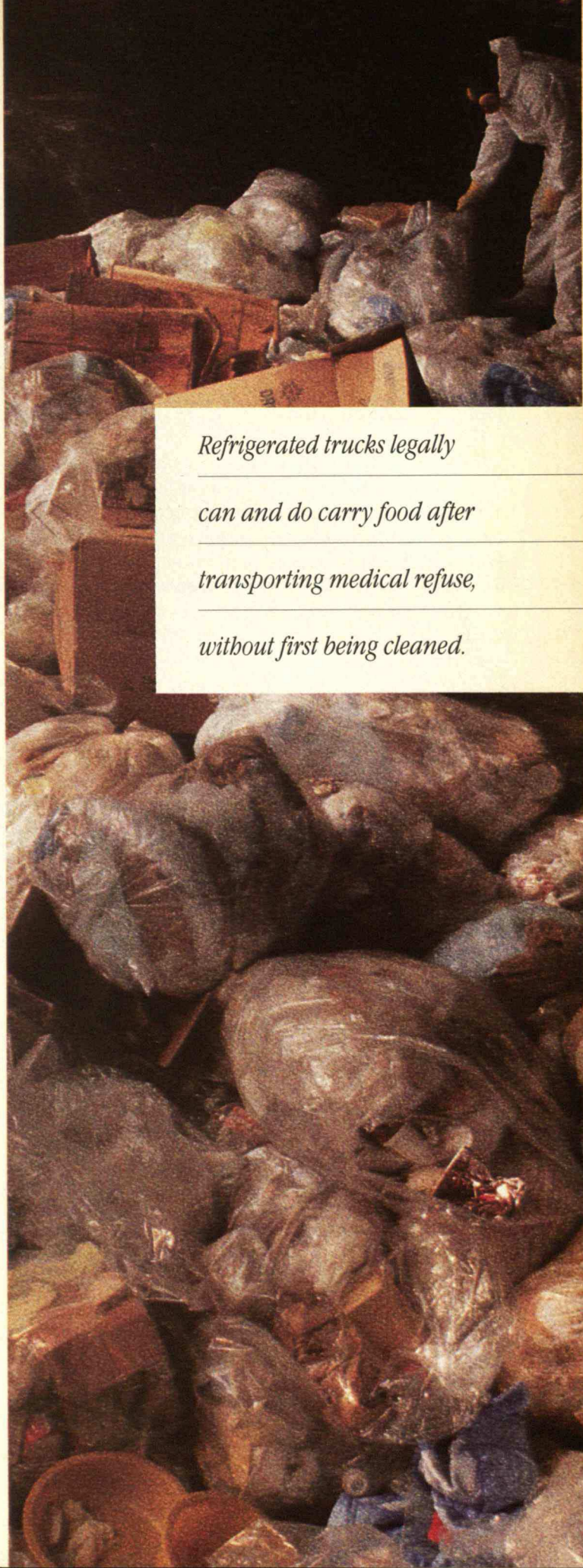
For extra protection, Germans stipulate that only licensed haulers operating marked, specially designated vehicles can collect medical waste. Truckers must alert incinerators that shipments are on their way. Trucks then drive down a special entrance lane at the incinerator and dump their loads onto a conveyor belt used only for the medical-waste furnace.

To ensure that all medical refuse goes through the system, both Switzerland and West Germany require complete manifests of transported waste. The German form indicates who created the waste, the type of waste generated, the transporter, and the facility that treats and disposes of the waste.

The first party to handle the form is the waste generator. In hospitals a specially trained waste-treatment supervisor, a position that does not exist at most U.S. hospitals, fills out the form. The generator keeps a copy of the form and sends another to the state environmental agency within 10 days. The remaining four copies of the manifest go to the trucker and then the disposer. After completing their jobs, they each sign and keep a copy. The disposer sends the final two copies—signed by every party—to the state agency and the waste generator.

It would not be difficult for the United States to develop transportation regulations along the lines of those in Switzerland and West Germany. The law could require that medical facilities distinguish wastes that are radioactive, toxic, infectious, or pathological. The wastes could also be assessed for their combustibility, moisture content, and—when they are not infectious or pathological—recyclability.

Sites that produce more than, say, 50 pounds of med-



Refrigerated trucks legally can and do carry food after transporting medical refuse, without first being cleaned.

ical refuse a day also need medical-waste managers to assure that all employees sort waste into appropriate categories. And as in West Germany, these supervisors could be responsible for a six-part manifest tracking system, which can reduce the threat of liability claims.

All people handling the waste on the way to regional autoclave or incineration plants need to be licensed professionals. Workers can be further protected by safe, standardized waste packaging. Finally, medical refuse should travel in vehicles used only for that purpose.

Dangers from the Home

While the major public-health problems associated with medical waste could be handled by developing sound regulations for hospitals, the economic problems from refuse washing up on beaches stem from a much more divergent group of generators. Several federal agencies—EPA, OTA, and Centers for Disease Control—as well as New York's Department of Environmental Conservation, have concluded that small generators account for most of the problems with medical waste on beaches. Most notable are medical clinics, home health-care practitioners, and intravenous users of illegal drugs.

Consider how many needles and syringes diabetics in New York City dispose of annually. If the city's 100,000 diabetics who inject themselves with insulin do so once a day, approximately 35 million syringes legally enter the city's waste stream. Many of these are flushed into toilets and from there into the city's antiquated sewage system. During rainfalls, that system pours material into rivers and then the ocean, and depending on tides and currents, syringes can end up on beaches. Yet no federal or state regulations deal with this issue.

The same is true in Switzerland and West Germany. Neither of these countries manages the substantial amount of medical waste generated in homes. But they do require pharmacies to accept old medicines for appropriate disposal, and to maintain records of what they collect. The pharmacies then send the medicines to regional incinerators or recycling facilities for metal recovery. This system helps keep children from getting their hands on medicine.

The United States could also have pharmacies collect old medicines—as well as syringes—using a deposit-and-return system. The pharmacies could then send the waste, in reusable containers that protect transportation workers, to appropriate autoclaves or incinerators.

Other small generators of medical waste, including labs, nursing and funeral homes, medical and veterinary clinics, and home health-care providers, could also send their refuse to regional treatment sites, directly or through hospitals. As in West Germany and Switzerland, small generators should not be exempt from air-emissions regulations covering incineration.

But such regulations may not restrain some small producers of medical waste. These include the estimated 1.2 million intravenous users of illegal drugs and, as the magazine *Hippocrates* pointed out last summer, clinics known as "Medicaid mills." These labs often trade drugs to people on the street for blood and other body fluids, and use the samples for tests reimbursable by Medicaid. In states like New York that have medical-waste regulations, such clinics may dump their wastes to deter detection. According to Daniel Millstone, head of the Environmental Police Unit of New York City's Department of Sanitation, in one recent case a clinic actually dumped radioactive waste. Reducing such illegal disposal requires that society starts dealing effectively with its drug problem.

The system I have proposed so far largely mimics the medical-waste disposal regulations of West Germany and Switzerland. But the United States would do best to go one step further and actually try to reduce the amount of medical waste produced.

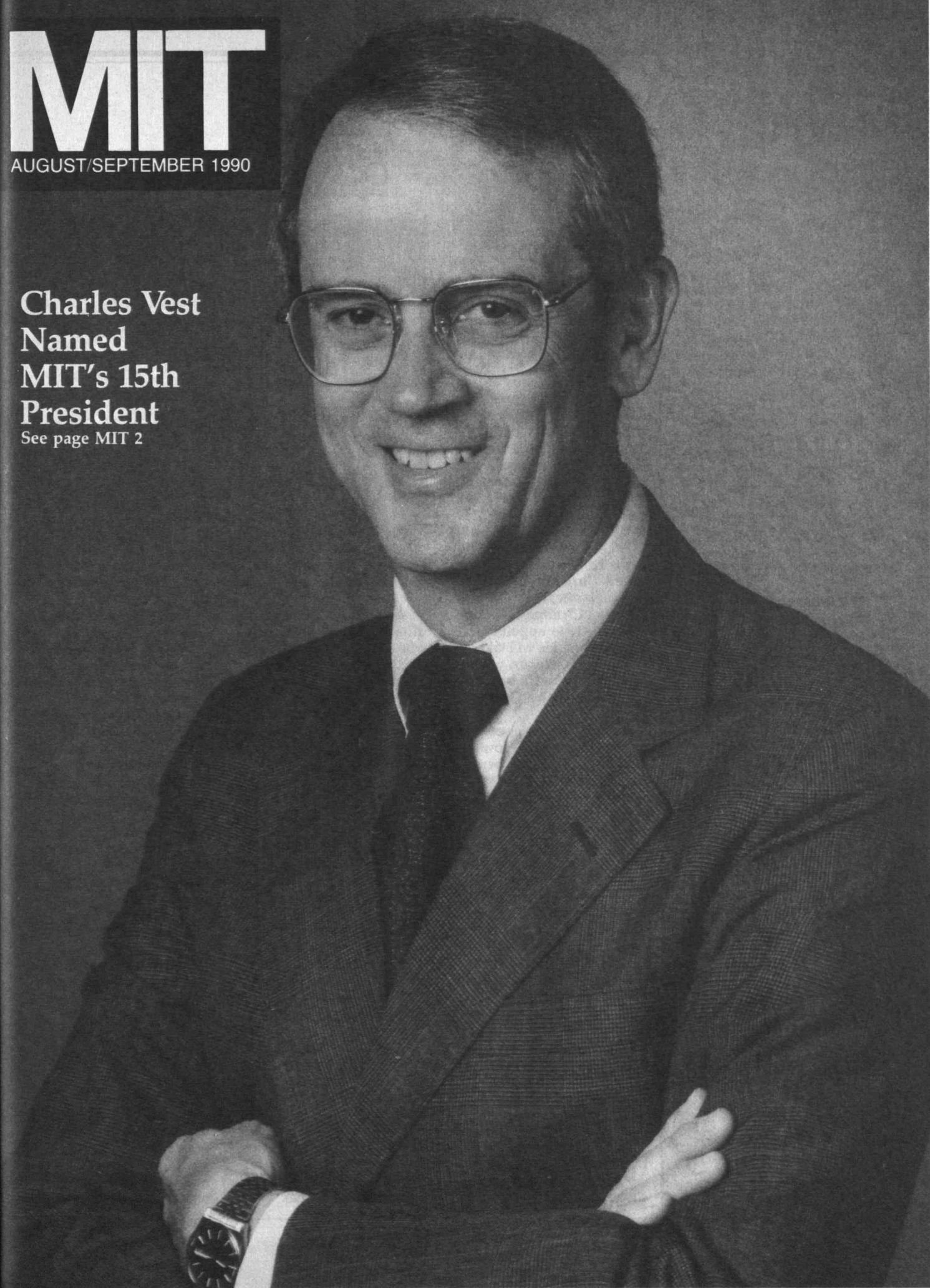
To this end, all institutions that generate medical waste need to conduct waste-reduction audits. After analyzing what materials they are using, waste generators could consider switching to products that have less environmental impact. For example, whenever possible hospitals might use glass jars and metal bins instead of plastic ones.

And like all other producers of waste, medical institutions should do their bit to reduce the amount of waste sent to landfills, incinerators, or autoclaves. These generators should also recycle paper and disinfected glass, metal, and plastic. Food and landscaping wastes should be composted. These steps might cut medical wastes by 10 to 30 percent and thereby reduce the pressure on landfills and keep costs under control.

Large and bureaucratic though they may be, hospitals can undertake these steps. In fact, the Nassau Suffolk Hospital Council, an association of a dozen private hospitals in Long Island, has been working to develop waste-reduction audits and recycling systems, as well as methods to safely send wastes to regional incinerators.

It's ironic that many products used in promoting and maintaining health are discarded in an unhealthy manner. A large-scale medical-waste management system could turn this situation around. Before Congress reauthorizes the Resource Conservation and Recovery Act—which is for waste the functional equivalent of the Clean Air Act—the legislation needs to be amended to promote safe disposal of medical waste. ■

MIT
AUGUST/SEPTEMBER 1990



Charles Vest Named MIT's 15th President

See page MIT 2

MIT
AUGUST/SEPTEMBER 1990

COVER:
Photo by Barry Hetherington

UNDER THE DOMES

University of Michigan's Vest Selected to Head MIT

Front row, from left: John, Kemper, and Rebecca Vest join the MIT faculty in applauding President-Elect Charles Vest.

The anfractuous search for the 15th president of MIT has finally come to an end: Charles M. Vest, provost of the University of Michigan and a former dean of engineering there, will take over the reins from Paul E. Gray, '54, in October.

At a special meeting on June 18, the Corporation voted "unanimously and enthusiastically," in the words of Chairman David S. Saxon, '41, to appoint Vest as president. He will take office in mid-October, whereupon Gray will become chairman of the Corporation.

Institute Professor of Economics Robert M. Solow describes Vest as the person who best "filled the template of what an MIT president should look like." "He has the experience, philosophy, and the personality that seems just the perfect fit for MIT," said Solow, chair of the faculty advisory committee on the presidential search. "We thought the faculty would find him easy to work with. [As provost] he has shown broad enthusiasm for the arts, architecture, humanities, and social sciences. He has thought a lot about the role of science and technology in the management of industry and in the nation, as well as in the university. He knows engineering and science."

U of M President James J. Duderstadt concurred. "MIT made the right choice," he said, describing Vest as a man of "extraordinary vision and depth" who is also "very persuasive, with that rare ability to get people to do things by [making them believe] they want to do them."

As provost and vice-president of academic affairs at Michigan, Vest has been responsible for the university's $1.6 billion budget, and the deans of the 17 schools report to him. His office also oversees research, information technology, medical affairs, minority affairs, academic personnel, admissions, and financial aid, as well as a large number of research centers and institutes. Michigan, with 35,000 students and 3,100 faculty, is more than three times the size of MIT.

A professor of mechanical engineering at Michigan since 1968, Vest is an authority on holographic interferometry—the use of three-dimensional imaging to make precise engineering measurements. He is the author of a standard work on the subject that has been translated into Russian and Chinese.

Vest's wife, Rebecca McCue Vest, runs a small business. Their daughter, Kemper, recently graduated from the University of Michigan and is a graduate student in international affairs at George Washington University. Their son, John, is a sophomore at the University of California/Berkeley and plans a medical career.

At his first press conference following the Corporation's vote, Vest acknowledged that this was not the time to attempt more than a general overview of how he saw MIT and its role in the coming years. Referring to the year-long search for a president, he observed that "what has been long and complex for you has been a whirlwind" for him and his family. And, when asked how long he intended to stay as president of MIT (he was provost at Michigan for only 18 months before he was tapped for the MIT post), he responded, "In my humble opinion, there's no where else to move on to. I

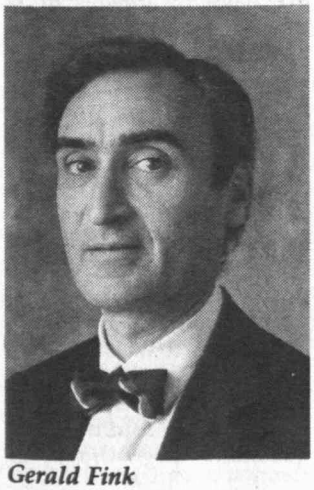
PHOTO: BARRY HETHERINGTON

think this is without question one of the finest opportunities any man or woman could be offered and I look forward, if the institution and the Corporation are willing, to many years of service here at MIT." □

Fink to Direct Whitehead Institute

Gerald R. Fink has been elected to succeed David Baltimore, '61, as director of the MIT-affiliated Whitehead Institute for Biomedical Research. Baltimore, founding director of the institute, has accepted the presidency of Rockefeller University in New York.

Fink pioneered the use of common baker's yeast as a model for understanding how genes function. He was the first to develop a method for introducing foreign genes into yeast and for finding retroviral-like particles in yeast that are like mammalian AIDS viruses. Another strong interest of his is basic research in plant biology—and the low funding accorded it in the United States. The result, says Fink, is that new ways to control weeds and pests without polluting the environment are being unnecessarily delayed.



Gerald Fink

A graduate of Amherst and Yale, Fink was a senior member of the Cornell faculty before his appointment as American Cancer Society Professor of Genetics at the Whitehead Institute and in the Department of Biology at MIT in 1982. He is a member of the NAS and the AAAS, and a former president of the Genetics Society of America. □

MIT Opens Center for Global Change Science

It is rather safe to assume that, riveting as it was, the Technology Day debate on global warming, "Is It Getting Hotter, or What?" has not decided the matter once and for all. Much study needs to be done, many factors need to be weighed, a lot of attention needs to be focused on what we are doing to our planet and how reversible the processes are.

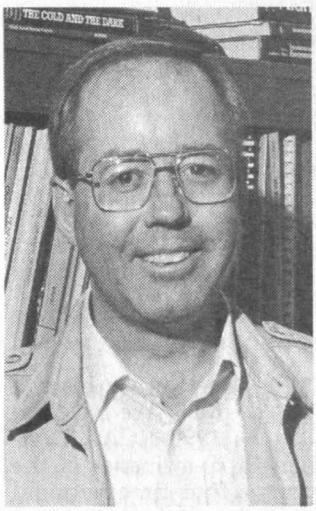
Toward that end, MIT has established a new Center for Global Change Science, which draws from expertise in the Departments of Civil Engineering, Chemistry, and Earth, Atmospheric & Planetary Sciences. Under the directorship of EAPS Professor Ronald Prinn, ScD '71, the center will focus on such issues as global climate change, destruction of the stratospheric ozone layer, and sea level rise.

While the controversy surrounding the question of climate change continues to generate enough heat to sustain itself, the new center intends to approach the subject in a dispassionate manner. Its organizational plan states, in part: "As scientific understanding of causal mechanisms for environmental change has improved in recent years, there has been a concomitant growth in public awareness of the susceptibility of the present environment to significant regional and global change.

"Such change has occurred in the past as exemplified by the ice ages, and is predicted to occur over the next century due to the continued rise in the concentrations of carbon dioxide and other greenhouse gases. The accuracy of current predictions of global climate change is, however, highly uncertain. This is because current climate models, including the most sophisticated three-dimensional general circulation models, have serious shortcomings.

"While it may be possible to improve somewhat on this situation by utilizing more and more powerful computers and attempting to incorporate whatever present understanding exists for the fundamental processes, we believe that accurate climate prediction will not be possible until an adequate scientific understanding is obtained of the fundamental processes themselves. Only then will these processes and their associated feedbacks be able to be included realistically in general circulation climate models."

The five fundamental processes are considered to be: atmospheric convection and cloud formation; ocean circulation and processes that couple ocean and atmosphere; land surface hydrology and its link with vegetation; the origin, dispersal, and destruction of the greenhouse gases (their biogeochemistry); and the chemistry and circulation of the upper atmosphere.



Ronald Prinn

In a letter to *The Tech*, Prinn and Director of the Center for Meteorology and Physical Oceanography Kerry Emanuel, '76, ponder why the uncertainties in predicting climate change are so large. Their own response is that progress has been held up owing to the "lack of new talent entering the disciplines of atmospheric, oceanic, and earth sciences.

"Ironically," they observe, "it seems that the more we talk about global change, the fewer good students decide to tackle the intellectually challenging problems in the physics and chemistry of climate. Consequently, the demand for climate scientists in the major research universities and laboratories worldwide far exceeds the supply." The new Center for Global Change Science hopes to help remedy that situation. □

PHOTO: NEWS OFFICE

1989-90 Sports Roundup

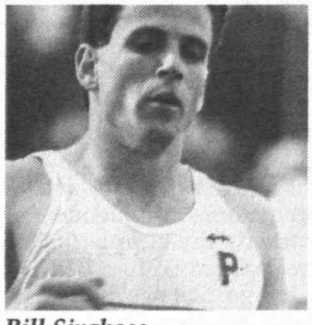
"Do They Really Have Sports at MIT?"

Sports Information Director Roger Crosley spends a fair amount of his time attempting to convince people that yes, MIT does indeed have sports. His job is made a little easier by the number of stellar athletes and teams at the Institute that he can cite to back up his claim. What follows is adapted from Crosley's address to the annual athletic awards dinner in May.

What do we have at MIT? We have the 1990 NCAA Division III co-swimmer of the year, a four-time national champion and the national Division III record holder in the 100-yard butterfly—who is also the 1989 New England Collegiate Athletic Conference Division III Women's Athlete of the Year. We have **Yvonne Grierson,** '90.

Yvonne Grierson

We have the best athlete in NCAA Division III . . . the 1989 decathlon champion, a man who qualified for the 1990 NCAA championship in six events, and, despite a severe leg injury that kept him from competing in individual events, placed second in the 1990 decathlon. We have **Bill Singhose,** '90.

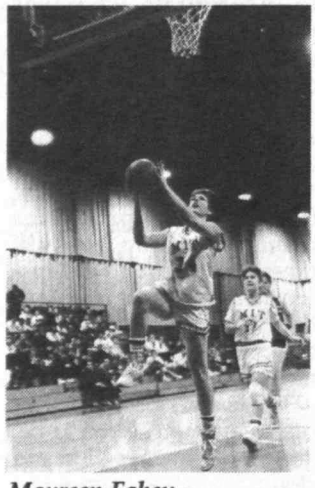


Bill Singhose

We have a football player who, in his first varsity game, gained 260 yards rushing . . . more than any other college football player in the country that day. We have **Shane LaHousse,** '90, and we have All-America **Bob Kupbens,** '90, blocking for him.

Kupbens and LaHousse

We have a women's basketball player who shattered the MIT career marks for points scored and rebounds, was an all–New England selection, was the New England Women's 8 Conference Player of the Year, an Academic All-America, and the winner of a prestigious NCAA Postgraduate Scholarship. We have **Maureen Fahey,** '90.

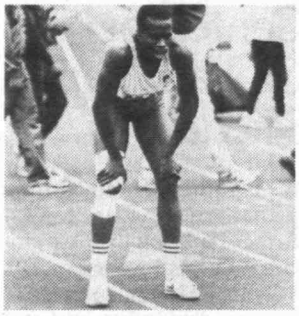


Maureen Fahey

Women's Crew

We have an oarswoman who, after being selected for the national development camp, won a bronze medal at the 1989 Olympic Sports Festival in the open fours plus coxswain. We have **Laura Opsasnick,** '90.

We have a track performer who is the 1990 Indoor National Division III champion in the 400-meter dash, and has earned All-America status eight times in only four competitive seasons. We have **Boniface Makatiani,** '90.



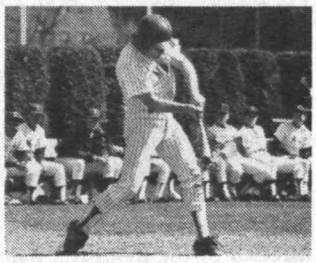
Boniface Makatiani

In women's volleyball we have the New England Women's 8 Player of the Year, a two-time All-East selection, who is also an Academic All-America in both volleyball and softball. We have **Cecilia Warpinski,** '90.

We have a gymnast who, through her sophomore year, has earned four All-America honors, and twice been team MVP. We have **Lisa Arel,** '92.

We have the winner of the first Woody Hayes Award for the outstanding scholar/athlete in Division III, who is also one of only 22 football players nationwide to be named a National Football Foundation and Hall of Fame Scholar/Athlete. We have **Anthony Lapes,** '90.

We have an athlete who has been named Most Valuable Player in two different sports—baseball and football—and who has also been named a recipient of the Eastern Collegiate Athletic Conference Award of Valor. We have **Tim Day,** '90.



Tim Day

We have a men's cross country Most Valuable Player who accomplished that feat at 31 years of age. We have **Jim Garcia,** G.

We have a women's fencer who first picked up her sport in an MIT physical education class . . . and in 1990 qualified for the NCAA Championships. We have **Alice Chang,** '90.

We have 20 athletes in six different sports who have received 42 different All-America honors in 1989-90. We have 15 athletes in 12 different sports who have already been named Academic All-America, including Bill Singhose, who was named GTE College Sports Information Directors of America Academic All-America of the Year. We have a coaching staff featuring nine members who have been conference, regional, or national Coach-of-the-Year Award winners. We have 37 varsity sports, more than any other Division III college in the country. Next question?—*Roger Crosley* □

PHOTOS: KRISTINE AUYEUNG/DAVID ROTHSTEIN/MICHAEL FRANKLIN/WILLIAM CHU/THE TECH

A Commencement demonstration by students from the Coalition Against Apartheid went ahead without incident.

Dean Wilson Stepping Down

After nine years as dean of the School of Engineering, Professor Gerald Wilson, '61, has announced that he is resigning that post effective September 1. During his tenure as dean, the School of Engineering has played an important role in several Institute enterprises: Project Athena, the School of Engineering Commission on Undergraduate Education, the Leaders for Manufacturing Program, and the groundwork leading to the formation of the MIT Commission on Productivity.

Wilson, the Vannevar Bush Professor of Electrical and Mechanical Engineering and former head of Electrical Engineering and Computer Science, has been a strong advocate of a five-year program for professional engineers. In addition to providing an indepth knowledge of a particular engineering discipline, Wilson has suggested, educators must revamp curricula that focus on analysis while shortchanging synthesis and must address the impact on human societies of the products of engineering. Four years is not enough time to turn out a professional engineer who has acquired both a technical education and adequate knowledge of social and economic realities, he has said.

In his letter to the faculty announcing his decision to step down, Wilson said, "This school and this faculty are truly outstanding by every substantive measure. I urge you to continue to seek the path to the future that is consistent with your convictions. Do not allow simplistic labels to deter you from following your conscience. I am convinced more than ever that you will continue to lead in directions for others to follow." □

Gerald Wilson

McBay Resigns as Dean; Smith Assumes Post

After 10 years as the dean for student affairs, Shirley McBay has resigned, effective June 30, to become president of the national Quality Education for Minorities (QEM) Network. The network was formed to implement the recommendations of the QEM Project, a 30-month study directed by Dean McBay and funded by the Carnegie Corporation of New York and MIT. McBay will initially be on a two-year supported leave, and the Network will continue its MIT connection: President Paul Gray, '54, will serve on its board and Professor Kenneth Manning will be its technical advisor.

Published in January, the QEM Project's report made 58 recommendations concerning the educational problems of five minority groups: Alaskan Americans, Native Americans, Mexican Americans, African Americans, and Puerto Ricans. "Through the QEM Network," said McBay, "we will work with other individuals and groups to help make quality education for minority children and youth, indeed for all children and youth, a reality."

Praising McBay's contributions as dean for student affairs, Provost John Deutch, '61, said, "She has brought wisdom and high standards to every aspect of her work and she is in large measure responsible for the successful steps MIT is taking toward becoming a university characterized by diversity and civility."

Shirley McBay

Professor of Electrical Engineering Arthur C. Smith has been named to a one-year term as acting dean for student affairs. In addition to serving as chair of several committees on student affairs and academic policy, Smith was chair of the faculty from 1983–85, and received the Gordon Y Billard Award for distinguished service to the Institute in 1987. A professor of electrical engineering since 1959, Smith's work has included studies in thermoelectric energy conversion and semiconductor research.

In announcing the appointment, Deutch commented that Smith's "deep understanding of the institution and of the concerns of the students, developed over more than 30 years as a teacher, faculty leader, advisor, and father of two graduates, make him uniquely suited to this position." □

45 Members of AEPi Discharged

Forty-five members of Alpha Epsilon Pi were "reorganized" out of the MIT chapter by the Jewish fraternity's national organization, allegedly for

PHOTOS: PAULA LERNER/NEWS OFFICE

violations of its risk management policy. The 10 brothers invited to remain declined the offer, rendering the chapter temporarily inactive. Subsequently, MIT withdrew its recognition of AEPi as an independent living group at the recommendation of the Interfraternity Council.

The three infractions of the Fraternity Insurance Purchasing Group (FIPG) policy cited by the national organization were the discovery of an empty beer keg at the house, several pledges stealing street signs on an out-of-state trip, and postering—or publicly advertising—for a party given at the fraternity. The AEPi members admitted that these violations had occurred but declared that they had made attempts to redress the situations—and that the punishment, in any case, was far out of proportion to the crimes. According to one AEPi member who was not discharged, chapter reorganizations of this magnitude were undertaken recently at two other colleges, but for alcohol-related deaths.

There appears to be a general feeling among AEPi members, both those dismissed and those invited to stay on, that the reorganization had more to do with religious discrimination than with insurance infractions. Of the six or seven Jewish members, four were asked back. In addition, when the national organization was conducting interviews of AEPi members prior to the reorganization, little emphasis was placed on insurance regulations and alcohol violations, the members said, while they were questioned extensively about why they had joined AEPi and what they felt about the fraternity's commitment to Judaism.

The Undergraduate Association Council endorsed a resolution condemning the fraternity's expulsion of the 45 students and discouraging MIT students from joining AEPi at this time. While a few of those invited to remain have since chosen to maintain their affiliation with AEPi, most have joined with the discharged members to form a new fraternity, Delta Pi, with no national affiliation. It is currently unclear what AEPi's status will be when school resumes in the fall. □

Lincoln Lab Report

Last year the Lincoln Laboratory, a federally funded R&D center operated by MIT since 1951, underwent its first faculty committee study in 17 years. The Ad Hoc Committee's report, issued in November, concluded that the relationship between the Institute and the Laboratory was a healthy and profitable one and recommended that it continue, with a few minor modifications. One of those was to review the arrangement every five to seven years.

"The major advantage [to the nation] of having MIT operate Lincoln is that the quality of Lincoln's staff is high," the committee said. "Creative people enjoy the relative freedom of a university-run laboratory, and the attraction of the MIT name to new hires cannot be denied. The committee also believes that Lincoln's connection to MIT strengthens the force of the Laboratory's positions, thus making it a more effective voice in Washington."

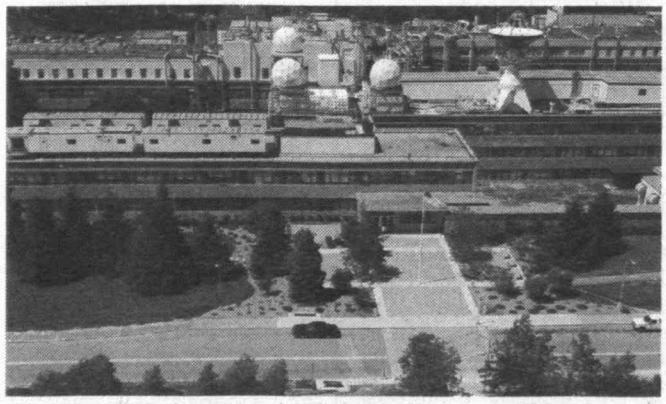
While most of the work done at Lincoln is supported by the Defense Department, the lab also does research for the FAA and NASA. About 875 of the 2,800 Lab employees are technical staff, and the FY89 budget was approximately $425 million.

The seven "mission areas" of the lab are: advanced electronics technology, high-energy laser-beam-control technology, surface and air surveillance, military satellite communications, strategic offense and defense, space surveillance, and air traffic control.

One of the primary areas of concern to the faculty committee was the "cultural gap" between the MIT campus and Lincoln Lab, which is located at Hanscom Air Force Base in Lexington, Mass., 15 miles from Cambridge. The committee believes that "the open exchange and debate characteristic of an academic environment" should, as far as possible, apply to the lab as it does to the campus. A corollary to this is improving the Institute's operations of the laboratory, for which the committee recommended that a 10-member faculty-staff-administration committee on Lincoln be established to oversee the implementation of the Ad Hoc Committee's non-financial recommendations. A Lincoln Laboratory Visiting Committee was also recommended. In addition, the review committee believes that MIT should seek approval of the DOD "to permit the publication of unclassified basic research papers by Lincoln staff without prior review, as is the practice on campus."

A second area of concern, the Ad Hoc Committee noted, is the extent to which MIT's "independence of judgment and decision-making ability" is influenced by the Institute's financial relationship with Lincoln. The committee called for steps "to limit or lessen the potential adverse financial effects" on the Institute if the time ever comes when MIT decides it no longer wants to manage it. Provost John Deutch, '61, estimates that MIT would lose $15 million to $23 million if it discontinued its involvement with Lincoln.

Calling the report "very constructive," Deutch said that the MIT administration will move in a "time-deliberate way" on the proposals "after we have had the benefit of anyone who has counsel to offer on these recommendations." □



The Lincoln Laboratory facilities in Lexington, Mass.

PHOTO: ROBERT NEWMAN, '89

DomeBits

GLOBAL ECOLOGY, GLOBAL ECONOMY

Two new degree programs have been added to the nearly 100 currently offered at MIT:

■ The faculty has approved the Institute's first undergraduate degree program in environmental engineering science, to be administered by the Department of Civil Engineering. The program is designed to prepare students for careers in environmental engineering, management, and planning.

Commented Department Head David Marks, "Environmental change and deterioration are now widely recognized as one of the major issues facing humankind in the 21st century. Among the diverse manifestations of this problem are global phenomena such as increased atmospheric carbon dioxide concentration, ozone depletion, tropical deforestation, soil erosion and desertification, and regional problems such as acid disposition, eutrophication of coastal and inland waters, hazardous waste accumulation, and the contamination of air, surface, and ground waters."

■ This fall MIT launches the nation's first advanced degree program focusing specifically on the management of technology. Offered jointly by the School of Engineering and the MIT School of Management, the program has accepted 42 mid-career managers in scientific and engineering fields from 12 countries. Upon completion of the one-year curriculum, they will receive a master of science in the Management of Technology.

Program Director Roger Samuel, '66, said, "The wide variety of technical backgrounds and accomplishments [of students in this program] add an enormous enrichment to a rigorous curriculum. In addition, the representation of Western Europe, Asia, and Latin America drives home the needed awareness of the challenges and opportunities of a global economy." □

The Tech Model Railroad Club's semi-annual open house in early May was a big attraction for local residents. The club, founded in 1948, has approximately 5½ scale miles of track, at 1/87 scale. Its twenty-odd members consist of an even mix of alumni/ae and current students.

TUITION, ROOM, AND BOARD TOPS $20,000

A 7.1 percent increase in tuition, room, and board at MIT for the 1990–91 school year brings the grand total to $20,700, up from last year's $19,335. Undergraduate tuition alone will increase 7.6 percent to $15,600. The percentage increase is slightly less than in 1989–90.

According to President Paul Gray, '54, the increase is necessary because tuition traditionally pays for only about half the cost of education, with the balance coming from endowment earnings and unrestricted gifts and grants. Food and salary costs were cited among the increased expenditures of the Institute.

Gray emphasized that MIT's policy of need-blind admissions—enrolling qualified students regardless of

their economic situation—will continue. More than half of the undergraduate population receives some form of financial aid through scholarships, loans, and term-time jobs. The self-help level, or amount a student is expected to provide before receiving scholarship assistance, has been raised $400 to $5,700 per year. Students from very low income families, however, have a lower self-help requirement. □

NAVY RECONSIDERS REPAYMENT

Former Naval ROTC cadet Robert L. Bettiker, '90, won't have to repay the $38,612 ROTC scholarship money that he had received before the Navy gave him an "honorable discharge for the convenience of the government" because of his of his sexual orientation. (*See July, page MIT 4-5.*) He received a copy of a memorandum from the secretary of the Navy to the chief of Naval personnel that said, "Midshipman Bettiker's case has been reevaluated and, due to extenuating circumstances, the requirement of reference for active duty or reimbursement upon disenrollment from the NROTC program is waived."

Last fall, Bettiker informed his commanding officer that he was gay and he was immediately disenrolled. In April, Provost John Deutch, '61, wrote to Secretary of Defense Richard Cheney, saying that it was "wrong and shortsighted" to maintain "the ROTC policy not to accept gay or lesbian students into its programs and to require avowed homosexuals to disenroll and pay back scholarship funds." □

PLAYFUL LEARNING AND HARD FUN

LEGO Professor of Learning Research Seymour Papert has a new megatoy to play with. Nintendo, the giant Japanese video-game manufacturer, has pledged $3 million to the MIT Media Laboratory for Papert to study how children learn while they play.

Now that Nintendo systems have seized the attention of children in some 40 million households around the world, it has finally occurred to Nintendo Co. Ltd. that such a grip might be put to a little more constructive use. The company was convinced by a visit last winter from Papert, Media Lab Director Nicholas Negroponte, '66, and artificial intelligence pioneer Marvin Minsky that joining forces could benefit both education and the game industry.

Although Papert and the Media Lab are not under any obligation to provide educational software for video games, Nintendo undoubtedly has high hopes. Up until now, the company has proved successful at only the entertainment side of the equation—and even then it comes under considerable criticism for the violent and sexist nature of a number of its games.

Papert is known for his development of the Logo computer language which, combined with LEGO building blocks, makes it simpler and more enjoyable for children to learn about such subjects as physics, geometry, and engineering. Logo is currently used by one third of the nation's elementary schools.

Where parents might see only mindless escapism in the lure that video games hold for children, Papert sees an opportunity to further explore the links between play and learning. "You have to work from within the culture as it is," he says. "You can't just make changes in school. Any new thinking about changes in children's learning have to be rooted in activities they are engaged in. Nintendo is one of the most frequent topics of conversation among young boys."

Once Papert figures out just what it is about Nintendo that children love, then he can explore ways to incorporate those features in learning activities. The interactive nature of the video games, allowing players to make decisions and choices, should be fertile ground for more mentally stimulating applications. Papert believes that children learn best when they can experiment, just as scientists do. A student in a local LEGO/Logo program described what she was doing as "hard fun"—and Papert says that the phrase is equally apt for the MIT/Nintendo partnership. □

EDGERTON AWARD TO BUCHWALD

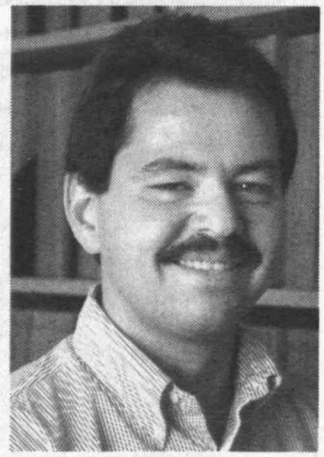
Associate Professor Stephen L. Buchwald, an internationally known organometallic chemist, has received the 1990 Harold E. Edgerton Award.

The award, which carries an honorarium of $5,000, was established in 1983 with contributions made by the faculty in honor of Doc Edgerton. It recognizes young faculty members for outstanding achievement in research, scholarship, and teaching. The award committee's citation said that Buchwald "has demonstrated a commitment to excellence in each of these dimensions."

"He has synthesized extraordinarily interesting molecules such as benzyne and cyclopentyne complexes which he fully characterized," continued the citation. "With the new complexes, Buchwald has developed efficient synthesis of pharmaceutically important compounds. . . . His research, conducted at MIT and presented in 22 research papers is significant, original, and definitive."

Buchwald's work has been recognized by numerous awards, including two Union Carbide Innovative Recognition Awards, an Eli Lilly Award, an American Cancer Society Award, an A.P. Sloan Fellowship, and a Camille and Henry Dreyfus New Faculty Award.

Since joining the faculty in 1984, Buchwald has trained eight undergraduate UROP students, all of whom have gone on to seek PhDs; under his supervision, seven students have received PhDs and nine more are pursuing them at MIT. In 1989 he received the Camille and Henry Dreyfus Teacher-Scholar Award. □



Stephen Buchwald

PHOTO: BARRY HETHERINGTON

Thermo Electron Corp. President and 1990 New England Inventor of the Year George Hatsopoulos, '49, presents Zhen-Hong Zhou with his grand prize of 10K.

10K CONTEST WINNER ANNOUNCED

Zhen-Hong Zhou, a graduate student in electrical engineering, is the happy recipient of $10,000—the grand prize in the first annual 10K Entrepreneurial Competition. His invention is called the ZZ High Yield Laser Particle Remover for Semiconductor Wafer Cleaning.

The contest, co-organized by the MIT Entrepreneurs Club and the Sloan New Venture Association, attracted 64 entries campus-wide, evenly divided between engineering and Sloan School of Management students. Each participant submitted a five-page executive summary of their ideas and plans, from which 11 were selected to go on to phase two, which called for a full business plan. The judges for the event were four members of the Boston business community, who evaluated the summaries as if they were a venture capital firm choosing companies in which to invest.

At the gala "Celebration of Student Entrepreneurship" held to announce the contest results, the judges made it abundantly clear that choosing the first and second place winners was a difficult exercise. The other nine finalists, the judges emphasized, should seriously consider pursuing alternate avenues to market their inventions.

Second prize and $5,000 went to a team of first-year graduate students at Sloan—Mark Hansen, Frederick Diehl, Samuel Kho, and James McGraw—for their Datatools, Inc., proposal to optimize database and networking operations. □

WIDESPREAD CHEATING IN 1.00

Nearly 80 students in Introduction to Computers and Engineering Problem Solving (1.00) are accused of turning in duplicate code on problem sets. Their professor, Nigel Wilson, SM '70, had told the class that while he would like every student to solve every problem alone, he recognized that that was unlikely. "If a student got stuck," said Wilson, "it was appropriate for him to speak to a TA, another student, or myself. However, jointly written code and the submission of jointly written code were unacceptable."

The plagiarism came to light in late April when a student expressed his frustration to Wilson that others were cheating and unjustly raising the class average. Once alerted, Wilson and his TAs devised a computer program to test for duplicate code and uncovered evidence that about a third of the class of 240 students was cheating. Some appeared to have collaborated on only one or a few problem sets, while others apparently stole other people's programs. The original 90 students suspected were winnowed down to 78 after careful examination of the screened codes.

The Committee on Discipline, chaired by Professor Sheila Widnall, '61, is reviewing the cases and will rule in the fall. □

Salute to Russell at TDC Centennial

Lindsay Russell's family had a special reason to join in honoring him: all the men are members of the MIT chapter of TDC. Left to right: brother-in-law Marshall Baker, '48, sister Dorothy Baker, nephew Ed Baker, '74, and Russell himself.

Nobody said it, but they could have: "Lindsay Russell is 'Mr. Theta Delta Chi.' "

On the 100th anniversary of the founding of Theta Delta Chi's MIT chapter, Theta Deuteron, friends, colleagues, relatives, and fraternity brothers of all ages turned out to toast and roast Lindsay Russell, '50, in recognition of his remarkable service to the chapter and to the Institute over the past 40 years. Russell was "surprised" (he admitted to having caught wind of the plan some weeks before) with a tribute at the centennial luncheon on April 7 at Anthony's Pier 4.

The banquet also celebrated achievements of Theta Deuteron. Chris Roak, president of the Theta Delta Chi Grand Lodge, was on hand to present the chapter with the international fraternity's Victory Cup Award for Most Outstanding Charge, which was announced at the last national convention.

Since this was to be, in the words of Scott Kieff, '91, TDC executive vice-president and emcee for the event, "a day about friendship," much attention was paid to Russell's untiring concern for his many friends. Associate Dean for Student Affairs James Tewhey suggested that Russell's approach to the world can be summed up in the words inscribed over the gates of Carthage: "All who pass through here are our brothers and sisters." He observed that "whoever comes into contact with Lindsay comes as his brother or sister."

Tewhey also reflected that when the leaders of the French Revolution called for "fraternity, liberty, and equality," fraternity meant caring for others above all else. "I can't think of anyone at MIT," he said, "who epitomizes that notion more than Lindsay, who has worked untiringly not only for his fraternity and the fraternity system, but for MIT as a whole."

Indeed, Russell's work has been wide in scope. He served on the Theta Deuteron house corporation for 30 years, and his was an active presence. Matt Rita, '89, a former house president, found that Russell's years of experience with the organization endowed him with a seasoned perspective that was of enormous value in coping with problems. "Russell improves everything that he touches," continued Rita. "The theme of elevation, of lifting things to new heights, can be seen throughout his life and work.... In terms of our house, he even added a new floor!"

Russell has also worked consistently for the fraternity system. Most recently, according to Neal Dorow, advisor to Fraternities and Independent Living Groups, Russell's efforts were critical in enabling Alpha Phi to become the first sorority at MIT to have their own residential house, which will open in the summer of 1991.

The fact that Russell's professional work as well as his volunteer activities have been marked by his concern for others was illustrated in remarks by Robert Mann, '50, Whitaker Professor of Biomedical Engineering, a classmate and longtime colleague of Russell. Mann told the story of John Dupress, blinded and maimed in combat in the Battle of the Bulge, who, as a member of the MIT research staff in the 1960s, tried to persuade scientists to use technology to help people with chronic disabilities, in particular the vision-impaired. Dupress found a ready collaborator in Russell. Perhaps Russell's most significant achievement in this area, Mann said, is the Pathsounder, a sonar device carried by blind persons to assist them in navigating through a clut-

PHOTOS: CHRISTOPHER NIESSEN, '93; RAPHAEL BEJAR, '93

For new pledges, the TDC Centennial and Russell tribute were a great way to learn a lot of chapter history. Left to right: Terry Spurling, Ed Adlerman, Shakil Chunawala, and Tim Olson, all members of the Class of '93.

tered path, such as a busy city sidewalk.

Russell has also been a key player for the Class of 1950. For example, he helped to devise the very first class-sponsored endowment fund for student aid. To this day, the Class of 1950 maintains the largest and most significant of all class student aid funds.

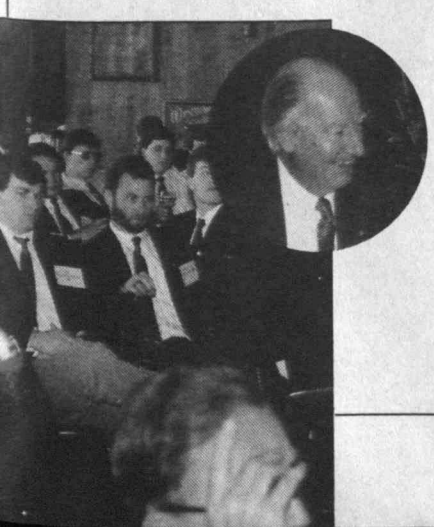
Russell, in responding to these words of praise, was reticent to accept any honor. "The day I was asked to be on the [Theta Deuteron] Corporation," he said, "was one of the luckiest days of my life." He described the privilege he feels each year as he returns to the house to watch the brothers arrive for the new year. His birthday happens to fall in late August, but due to this happy coincidence, "I don't think of it as being a year older, I think of it as 'Room choice this weekend!' "

Work Week is one of his favorite times of the year, an attitude he acknowledged is unusual. Russell joked about his plans for writing "some kind of a treatise or monologue on work," suggesting titles like "Great Moments in Housecleaning" or "Annals of Work Weeks Past." For him, however, Work Week is a time to get his "psychic battery recharged....Work Week is where the extreme enthusiasm of the beginning of the year comes to a peak. I am lucky to participate in that excitement year after year." He sent words of encouragement to the current and future presidents of TDC, reminding them that "when there is all that furor of activity and you have so much to worry about, however frenetic the pace is, savor that hour, because for most of us it passes very fast and it comes only once."

Russell's successor on the House Corporation Committee, Dan Geer, '72, was also introduced at the luncheon. Geer, the house president in 1971, saw TDC through some tense times for fraternities everywhere. Russell praised Geer's work, saying "the fate [of TDC] rested on a handful of presidents who guided by keeping straight and clean and not being nerdy or heavy about it."

Besides his presidency, Geer was saluted for his efforts on behalf of Frances Swain, who worked for TDC for more than thirty years. After her husband died and her son was killed in California, Geer took over Swain's finances, setting up a trust fund for her and locating an affordable apartment. Recently, Geer helped her make the transition to a nursing home. Geer acknowledged Russell's significance in his life at MIT. His voice noticeably choking, he told the crowd, "I don't know how I'm going to stand in [Russell's] shadow, but I'd appreciate your help."—*Leslie Jeffs* □

The author is a freelance writer.



When the members of TDC gathered at Anthony's Pier 4 to celebrate, Bob Mann (inset) was one of the many speakers who highlighted the achievements of his classmate, Lindsay Russell.

CALENDAR

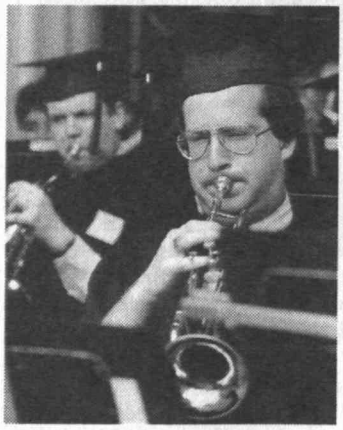
September 15
Alumni Leadership Conference
Contact: Eliza Dame
(617)253-8230

October 19-21
Family Weekend
Contact: Marcia Hartley
(617)253-0743

September-November
Alumni Fund
Regional Telethons
Atlanta, Hartford, Houston, Washington DC, Wilmington DE, Boston, Philadelphia
Contact: Janet Serman
(617)253-8242

September-November
Alumni Fund
Visit Programs
Baltimore, Detroit, Boston, Silicon Valley, San Francisco, St. Louis, Chicago, Atlanta, Washington DC
Contact: Joseph Collins
(617)253-8210

COMMENCEMENT 1990



Commencement '90 had its moments. Everyone will remember the tight security. While international leaders have spoken at Commencement before (former Chancellor of West Germany Helmut Schmidt in 1983, for example), the measures to protect Colombian President Virgilio Barco, '43, must have been the most intense and sophisticated ever seen on this campus. Secret Service person-

PHOTOS BY PAULA LERNER/
ROBERT NEWMAN, '89

We are entering a world where entrepreneurs and innovators, not generals, will lead the way."

nel were unmistakable: conservatively tailored men and women with wires going from their ears to pocket receivers, talking into their wrist watches and scanning the crowd like spectators at a slow-motion tennis match.

Graduates, faculty, and Corporation members filed into Killian Court past a contemporary Cerberus—two police cars, each heavily screened back seat entirely filled by a German shepherd, who barked and strained at being thus confined.

Barco was scheduled to leave the platform before the ceremony ended, via a secure back stairway. But he was having such a good time that he decided to stay and join President Gray for the recessional. The Secret Service personnel went right through the roof—or the azaleas, as the case may be—at the unannounced change of plan, but their sangfroid was the only thing that was damaged.

The associate provost for the arts sang the national anthem. When Ellen Harris got to the "the land of the *free*," it was arguably the longest sustained note ever heard in Killian Court. Absolutely sublime.

Although there was a sudden burst of activity from TV crews covering their cameras in plastic as clouds gathered overhead, the rain that saturated communities to the west bypassed Cambridge.

It was Paul Gray's last Commencement as president, the last major address of Barco's presidency, and the first time the invocation was given by the MIT president's daughter—the Reverend Virginia G. Army.

Gray delighted the graduates by recalling that their freshman convocation was "the most memorable of my tenure as president . . . the Kresge organ took on a life of its own, and punctuated my remarks with bursts of a Bach toccata. It was a terrific hack."

Gray talked about change—about the political transformation of Eastern Europe, the changes in both the environment and the way we *think* about the environment, and the development of a global economy. He emphasized that the Class of '90 will work in a country in which "people of color will become the majority and women will take their rightful place . . . " And in a reference to the difficulties of the past year in dealing with divestment demonstrations on campus, Gray said that "We have all learned something, and we all have something more to learn. And that is the importance of being able to differ with each other without being divisive, of being able to listen, even when we think we've heard it all before."

Gray also noted that "Commencement addresses are a difficult art form." The graduates and their families are eager to get on with the rest of life, Gary observed, and "the conventional range of subjects is narrow." Virgilio Barco, however, eschewed the conventional range of subjects to deliver a message to the graduates and the American people that is rarely heard and still more rarely attended to: democracy is not just breaking out in Eastern Europe, and it is not only fought for by students in China, it is flourishing in Latin America.

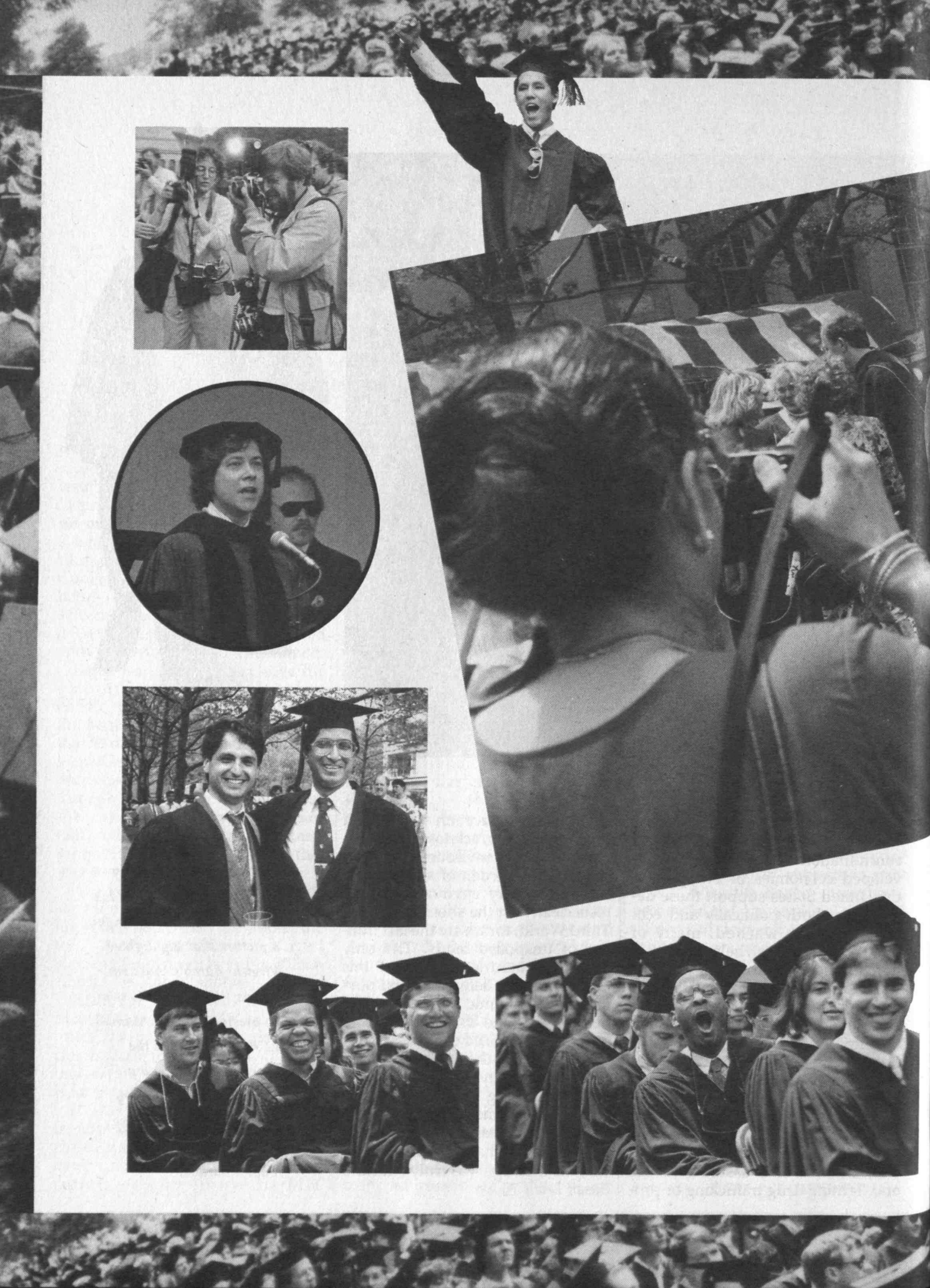
Democratically elected governments have replaced military dictatorships in many South and Central American countries in the past decade, Barco noted, with relatively little fanfare from outside their borders. Their achievements are

often ignored by countries obsessed with the Cold War and East–West confrontation. And unless the developed economies of Europe and the United States support these democracies both politically and economically, he warned, many of them could be overwhelmed by economic problems, drugs, or both.

Barco spoke slowly and with great care, lest any of his clear thinking be clouded by his elegant, Spanish-accented English. An economist by training, he predicted that the 1980s would be remembered as a decade of the resurgence of free market economics. But he cautioned that "free market policies should not be used as an excuse for the lack of political will, whether it is assuring justice and fighting drug trafficking or providing basic education and health care." Barco, too, acknowledged the importance of environmental concerns. "The burden of sustaining a viable planetary environment now rests clearly on the shoulders of the Third World, for we are the last frontier of unspoiled lands. The only way our countries can meet this challenge is by defeating rural poverty and economic stagnation. The best way for the United States and other industrialized countries to pay their ecological debt to humanity is to be partners in this cause."

The standing ovation accorded Barco is not unheard of for a Commencement speaker, but neither is it routine. One has to hope it means that his message was truly heard.—*Susan Lewis* □

The* Boston Globe *photographer practically needed a llama to carry his lens, but he was able to get a picture that highlighted Virgilio Barco's brass rat. Harris Weinstein, '56, who as president of the Alumni/ae Association led the procession, also had a weighty matter to carry, but the ceremonial mace was more a privilege than a burden.



The Institute's Family Album, so to speak: the 50-Year Reunion Class leading the graduates into Killian court, the many snapshots with Paul and Priscilla Gray, Associate Provost Ellen Harris singing the national anthem, the crush of photographers around President Barco, and, most important, the pensive, jubilant Class of '90.

88

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Anna Jean Hagen '89
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Kenneth Knyfd '75
Peter Kulsa '67
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Steven Ludmerer '86 '88
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Stephen Marburg '62
Prakash S. Masurekar '68 '73
David K. Matsumoto '87
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Robert B. Nachbar '80
Linda L. Ng '78
John H. Nielsen '51
Joseph F. Payack '87
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Kathleen Rupprecht '79
Walfred S. Saari '57
Vijay Samant '83
Wendy V. Sanford '89
Edgar M. Scattergood '58
David H. Shih '73
Melvin Silberklang '77
Robert D. Sitrin '67
Reed Steinmetz '88 '88
Michael C. Sudol '58
Richard J. Swanson '88
Michael P. Thien '88
Wayne J. Thompson '80
Alan Todtenkopf '88
David B. Volkin '89
John Suiman Wai '89
Shiping Wang '88
Gregory J. Wiederrecht '83
George T. Wildman '73
Joanne M. Williamson '78
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* *By a* Fortune *Magazine poll of more than 8,000 of the nation's business leaders and financial analysts.*

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Nurturing Creativity: The MacArthur Fellowships

BY JAMES WALSH

"I received the call while I was at a meeting in California," recalls Mark Wrighton, Frederick G. Keyes Professor of Chemistry and head of the department at MIT. "When I returned to the hotel, there was a message. It turned out to be the phone number of the MacArthur Foundation. I was supposed to talk with Ken Hope, who's . . . Hope. There's a certain amusement, in retrospect, in that name."

Like the 11 other MIT faculty and alumni interviewed among the 16 members of the MIT community who have won MacArthur Fellowships, Wrighton had not known about his candidacy, nor even much about the program's unique gift of hope and freedom. Each year, the John D. and Katherine T. MacArthur Foundation selects 25 to 30 creative individuals to receive an annual "no strings attached" grant for a period of five years. The MacArthur Foundation seeks to improve society by giving highly creative individuals the economic resources to follow their dreams. Because of the unusual nature of both the grants and the winners, the press has hailed the program as the "Genius Awards," a title that the donors and recipients universally dislike.

Much of the notoriety of the fellowships derives from the secretive selection process. To serve as nominators, the foundation recruits 100 anonymous volunteers who are established members of a wide array of disciplines. These hidden "talent scouts" pick possible fellows by using three criteria: What is the candidate's apparent potential? What difference will the award make in his or her work? Is that work significant and important to society? The nominators then submit the collected names to another secret panel, the Selection Committee, which, in turn, recommends possible finalists for approval by the foundation's board of directors.

Note that *they* must select *you*. No one can apply to became a MacArthur Fellow. The foundation does not set a quota for finalists, nor does it schedule an annual date for releasing the names. The resulting secrecy and flexibility of the process lends it an air of unpredictability that some compare to winning a lottery.

While the form of selection does build up a mystique, it also serves a more utilitarian function. "I think it's just pragmatism," said MacArthur recipient John Holdren, '65, a professor of energy and resources at the University of California, Berkeley. "They know, for example, that if the identities of their nominators became known, then the nominators would be buried in an avalanche of resumes and publica-

1983 ***Mark S. Wrighton,*** *professor and head of the Chemistry Department at MIT. His basic research in photochemistry and electrochemistry has led to the development of molecule-based transistors and new approaches to the conversion of solar energy to electricity.*

1984 ***Heather Nan Lechtman,*** *professor of archaeology and ancient technology with a joint appointment in Anthropology/Archaeology and Materials Science & Engineering at MIT. She specializes in the technological developments of prehistoric Andean culture, using the techniques of materials science and engineering as part of her toolkit.*

James Walsh, a senior at Harvard College, was a 1989 intern at Technology Review.

thinks Holdren, would anyone volunteer for such a nuisance. The process also supports the foundation's goal of searching for the most creative, not the most competitive, individuals.

The selection process represents a unique form of peer recognition. Heather Nan Lechtman, MIT professor of archaeology and ancient technology, believes that her fellowship helped legitimize her unusual work at the interface of materials science and anthropology. Eric Lander, a research associate at the MIT-linked Whitehead Institute for Biomedical Research, values his MacArthur "because it's a recognition of an individual for being different. There's an awful lot of pressure in the academic world to conform to particular models of what it means to be a scientist, or what it means to be an historian." Stressing the strong psychological value of the award, Lander said that it reinforced the notion that the odd point of view is useful too. For David Felten, '69, a professor of neurobiology and anatomy and of psychiatry at the University of Rochester School of Medicine, his willingness to take risks increased considerably after he was selected. "Part of that comes from the security of knowing that I have some 'drop dead' money from the MacArthur Foundation," Felten said, "and part from just knowing that people of the stature of that board, somewhere, sometime in my career, believed in me."

The size of the grants is related to age—with the larger grants going to older fellows—and now ranges from $30,000 to $75,000 annually for five years. The amounts are designed to support an individual while he or she creates, or to permit exploration of new fields for which conventional funding would be difficult to obtain. However, it does not provide a luxurious standard of living, nor does it create a sinecure.

Before receiving her grant, Randall Forsberg, director of the Institute for Defense and Disarmament Studies in Brookline, Mass., and a PhD candidate at MIT in political science, had lived an incredibly Spartan life. Her finances were so constrained that she had to write the essay that led to the founding of the Nuclear Freeze Campaign in 1980 on the back of used sheets of paper. After the collapse of that campaign, Forsberg and her staff members each earned less than $12,000 a year. "It was a killing exercise to try to live on nothing, and be tremendously insecure and worried about paying your own bills at the most basic level, and at the same time be trying to create an organization with larger but analogous problems," she acknowledges. The MacArthur Fellowship enabled Forsberg, a single parent, to persevere in her disarmament work. Almost as important, the health insurance package that came with it paid for life-saving medical treatment when she endured two bouts with cancer during her term as a fellow. She is now in good health, and her institute has a steady annual income of more $600,000 a year.

In addition to the health insurance, there are other fringe benefits that accompany the awards. For the first five years of its fellowship program, the MacArthur Foundation provided an additional "institutional grant" of $15,000 annually for each winner to give to the institution of his or her choice. Heather Lechtman donated this money to MIT. President Paul Gray, '54, in turn, returned the money to Lechtman,

1983 ***Randall Forsberg,*** *founder and director of the Institute for Defense and Disarmament Studies, a nonprofit research and education center that also publishes a monthly information service on arms control talks called* Arms Control Reporter. *A short proposal she wrote in 1980 is credited with launching the nuclear freeze movement.*

1983 ***David L. Felten,*** *'69, professor of neurobiology and anatomy and of psychiatry at the University of Rochester School of Medicine. He has found direct contacts between nerve terminals and the lymphocyte and macrophage cells of the immune system and is also working on intervention strategies for neurodegenerative disorders.*

who used it to support several PhD candidates working in the Center for Materials Research in Archaeology and Ethnology, which she directs. "It kept these students going in their doctoral dissertation research, which was terribly important, and made an enormous difference to their lives and to mine," she observed.

And every year in Chicago, the home of the MacArthur Foundation, many award recipients attend the MacArthur Fellows Reunion. Mitchell J. Feigenbaum, PhD '70, a professor of physics at Rockefeller University, has attended some of these gatherings. "That's an enjoyable few days, because a lot of the other fellows are interesting people, and it is a chance to meet very different people from those one usually meets in the university." David Felten concurred, adding, "I'm not sure who is more interesting, the MacArthur Foundation recipients or their spouses."

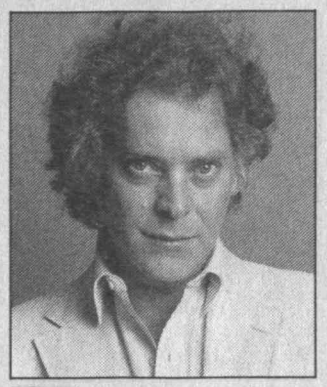
What does the MacArthur Foundation ask in return for its gift of money and prestige? Nothing. They only express a hope that the recipients may be able to follow their creative instincts. As Eric Lander put it, "Doing things that are non-standard is very risky, and any self-aware person worries about them. And I'm a worrier too. The MacArthur [award] is just very nice, because it says, 'Relax. Don't worry about it for a while.' It buys you some freedom."

Most recipients from MIT have invested their money in unusual research, or are waiting for an appropriate opportunity to do so. Others, like Randall Forsberg and John Harbison, a professor of music at MIT, live off the money so that they can pursue their work without needing to earn other income. David Page, an MD and fellow at the Whitehead Institute as well as a member of the faculty in the MIT Biology Department, used some of his money to pay off his medical school loans.

By placing its hope in the creative individual, the strategy behind the MacArthur Fellows Program embodies an American ideal. The United States has always prided itself on being a nation of free-thinkers and entrepreneurs, whose success revolutionizes and advances the community. One of the few rules in selection is that the candidate must be a U.S. citizen or a resident of the United States.

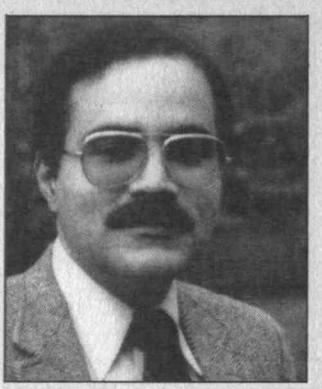
The program does seem to have been successful in making grants that prove socially valuable. For example, the fellowship permitted Eric Lander to divert energy from his research on genetic mapping and the applications of DNA polymorphisms to medical traits and focus on an important public policy issue. He served as an expert witness in a trial that set precedents for the admissibility of forensic DNA analysis. It was the first time such evidence was rejected—on the basis of inadequate laboratory standards. In a further development, Lander, with his unusual combination of mathematical and biochemical skills, was invited by a National Academy of Sciences committee to assist in setting uniform standards for DNA fingerprinting.

The MacArthur Fellowship certainly may be considered successful on an individual basis. Michael Woodford, PhD '83, a professor of economics at the University of Chicago, was inspired to attempt "something more ambitious." He used the money to lighten his teaching load and free his time for re-



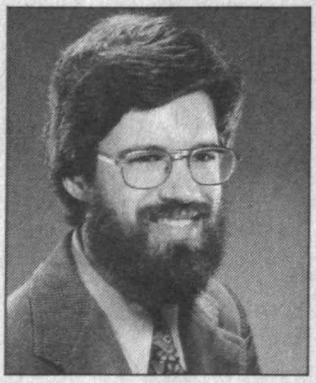
1984 ***Mitchell J. Feigenbaum,*** *PhD '70, professor of physics at Rockefeller University. His work in mathematical physics led him to discover a universal way a transition from order to chaos can occur. The discovery has had a broad impact on disciplines ranging from chemical kinetics and statistical physics to hydrodynamics and meteorology.*

1987 ***Eric S. Lander,*** *research associate at the MIT-affiliated Whitehead Institute for Biomedical Research and associate professor of managerial economics at the Harvard Business School. A mathematician with interests in molecular biology and computer science, he is currently working on genetic mapping.*



1981 ***Raphael Carl Lee,*** *ScD '79, professor of plastic surgery at the University of Chicago and former professor of bioengineering at MIT. His interests in reconstructive surgery and electrical engineering have led to in-vitro fabrication of connective tissues and new treatments for electric-shock injuries.*

1981 ***John P. Holdren,*** *'65, professor of energy and resources at UC Berkeley. With three degrees from MIT in Aero & Astro and a PhD thesis on theoretical plasma physics, his subsequent work encompasses energy technology, arms control, population growth, and global environmental problems.*

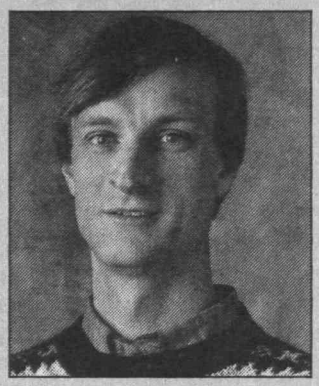


search on the role of expectations in determining monetary equilibrium and in certain areas of macroeconomics. Mark Wrighton used some of the money to help develop "molecule-based transistors," and some of it for travel. He still holds on to some. "It's sort of like an ace that you like to have in your pocket, so that you can feel confident when you take off on an adventure that may not prove as fruitful as you hope." And for David Page, debt was not the only problem left over from medical school. "[Thanks to the fellowship,] I felt somewhat vindicated for having made the decision to pursue a pure research career" over better-paid clinical medicine, he explained.

Just as there is no established definition of a MacArthur recipient, there is no established definition of success for the program. As Mark Wrighton points out, "I don't think it's possible to gauge the value of the MacArthur Fellows Program on the basis of looking at an interval of time as short as five years. We can't say, 'This led to this discovery, or to this play, or to this cure for some human disease.' I think it is really a program that allows people to feel more free to pursue those things that they regard as important." And for all the focus on the common good, the structure of the grant stresses freedom, not success. As John Holdren put it, "I'm a great admirer of the principle of diversity, and the unpredictability of what will happen if you spread some resources around. And that means, of course, that in retrospect you'll find that some things that happened weren't so interesting, and some of the money was not terribly well spent, and other things were fantastically interesting. It's very hard to know in advance which are going to be which."

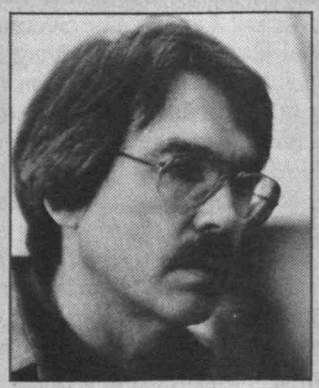
Some critics have complained that the distribution of the MacArthur Awards has been skewed towards white male academics. Randall Forsberg noted that, particularly in the early years, very few women received awards. Indeed, only two of the MIT recipients are women, but this may be more of a reflection of MIT demographics. The MacArthur trustees, for their part, refuse to implement any sort of quota, which would run counter to their policy of finding creativity wherever it lies. They do, however, recognize the imbalance and say they are trying to diversify the pool of winners.

The great majority of MIT MacArthur winners interviewed stressed the importance that the grants could hold for an artist. Mitchell Feigenbaum said, "This award is clearly very well designed for an artist. For those of us who have standard jobs, we have a well-defined place in the society that's well funded because society cares about scientific research." Artists, he observed, have never enjoyed that kind of public support, "and as we've seen over the past several presidencies, [arts] funding, little as it was, has been cut still further. That [Fellowship] really gives them a chance to cut free and do things." Composer John Harbison can attest to this. "I've felt that I haven't been able to take on any pieces for which I didn't have a commission, because I've spent a certain amount of time not teaching and not on any salary. But [now] I think I can write some pieces which are not being requested by any group." Harbison also noted that "there are other honors in music, like the Pulitzer Prize, which I won a few years ago, that are very important professionally but not practically. The [Pulitzer] money was not more than $1,000,



1986 ***David C. Page,*** *fellow at the Whitehead Institute and professor of biology at MIT. The recipient of an MD from the Harvard-MIT Health Sciences & Technology Program, he is working on identifying the genetic basis of sex determination in mammalian fetal development.*

1989 ***John Harbison,*** *professor of music at MIT. A composer, performer, conductor, essayist, and promoter of contemporary music, he won a Pulitzer Prize in 1986 for his choral work called "The Flight into Egypt." He has composed two operas and numerous vocal and instrumental works, and has been composer in residence for several orchestras.*



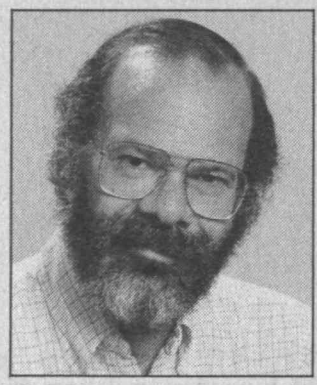
and they wanted me to come to L.A. for the dinner. It would have cost me over a thousand dollars to do that."

For all the money invested in science, however, scientists do not escape roadblocks to creativity. "If I wanted to do something new, and there's an important conference taking place in the Far East, and they're the world's experts in something I've never worked on, how am I going to have the resources to go to the meeting?" asks Mark Wrighton. "If I'm not [already] working on research in that vein, I can't justify it."

Another scientist who experienced roadblocks was David Felten, whose traditional neurobiological studies were well funded. However, NIH and other organizations by and large refused to support his experiments to explore the connections between neurons and the immune system. Felten reports that some of the responses to grant proposals he submitted with his wife Susan were quite insulting. Wrote one funding agency, "We do not understand how the Feltens could conceivably hypothesize any interaction between the nervous system and the immune system, however remote, since immune responses go on in a test tube and, to the best of our knowledge, test tubes are not innervated by post-ganglionic noradrenergic neurons." However, someone believed in his work and recommended him to the MacArthur Foundation. As a result, his experiments have helped to provide the basis for one of the hottest new fields in neurobiology.

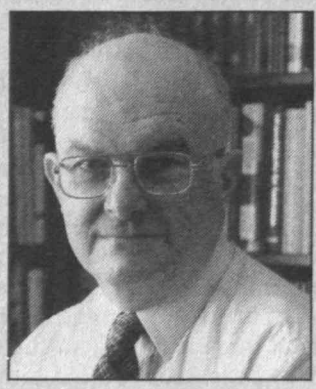
One MacArthur bias that is quite evident, yet not contested, is the high preference for interdisciplinary work. A good example of this is John Holdren, who before his award had done work in theoretical plasma physics and fusion, comparative risk of energy technologies, the impact of human population growth on environment, and the interaction of population, technology, development, and environment. Holdren's award cited him for his work in physics, energy, and the environment. His MacArthur money permitted him, in 1981-82, to spend more time on arms-control issues, which led to his accepting unpaid posts as chairman of both the Federation of American Scientists and the United States Pugwash Committee, as well as his membership on the Executive Committee of the International Pugwash Conferences. (Founded as a result of an initiative by Albert Einstein and Bertrand Russell, Pugwash is a private international group of scientists that includes Nobel Laureates and advisors to heads of state. They meet regularly to discuss various strategies for arms control.)

Raphael Carl Lee, ScD '79, now a professor of plastic surgery at the University of Chicago, has created an unexpected alliance between plastic surgery and electrical engineering. According to Lee, the same problem-solving skills used in engineering apply equally well to plastic surgery. His MacArthur Fellowship relieved him of some of his medical school debt, but more important, it permitted him to teach simultaneously at Harvard Medical School and MIT's Electrical Engineering Department. "I had a very unusual job. . . . To be perfectly honest, I don't really think I would have attempted to do that under the circumstances that were available, if it had not been for the MacArthur Award." His work has resulted in the creation of new treatments for electrical burn victims and the thorough exploration of "ligament-equivalent" materials made of fibroblasts in a collagen matrix.



1987 ***Ira Herskowitz,*** *PhD '71, professor of biochemistry and biophysics and head of the division of genetics at UC San Francisco. His "cassette model" of mating-type interconversion in yeast was a major conceptual breakthrough in the study of the genetic basis of cell differentiation.*

1984 ***Alar Toomre,*** *'57, professor of applied mathematics at MIT. He combines his teaching career with research in astronomy, particularly on the dynamics of galaxies, and is known for his explanations and computer simulations of galactic structures.*



A MacArthur Fellowship has mixed impact on the recipients' success in winning other grants. "The Foundation actually was worried for a while that people who got these awards were people who had been raising $300-, $400-, $500,000 a year, and in some cases more, to support their research groups," noted John Holdren. "And when they received [a MacArthur], which averages $40,000 or $50,000 a year, they found themselves being told by some of their major funders, 'Well, now you have a MacArthur, so you don't need our funding anymore.' " Raphael Lee believes the fellowships had the opposite effect. "I think that probably the biggest impact it had for me was that writing grant proposals became a bit more successful. . . . because the reviewers of my proposals were certainly aware that MacArthur Fellows have been closely scrutinized, and thought capable of doing something unique." David Page feels that the effect is negligible. In the competition for funds, he believes that "a lab is really judged on its accomplishments, rather than on its accolades."

The traditional pattern of public and private funding needed to be supplemented, in the MacArthur Foundation's view, rather than replaced, says John Holdren. "I think the biggest problem is that very few foundations are willing to fund projects in the long term. . . . It's very difficult these days even to get three-year grants, and five is unheard-of for research. A lot of the foundations and other funders solve their problem of decision making by simply dividing up the available money more finely. The result is basically 10 times as much work [for recipients]—in writing proposals and quarterly reports and the general care and feeding of sponsors—for the same amount of money, just because it's fragmented."

In the 10 years since the MacArthur Fellowships' inception, the foundation has given away more than $40,000,000 worth of hope and freedom. Or to put it in slightly different terms, as David Felten observed, "I have noticed something about the other MacArthur Foundation recipients that I like, and that is a tremendous sparkle and sense of humor, and a sense of joy at being alive. They know quite a bit about quite a bit, and generally tend to be dynamic, enthusiastic people, and that in itself is infectious. I leave the MacArthur Fellows Reunions thinking maybe there is hope for the world." □

Pictured on these pages are 12 of the MacArthur Fellows with connections to MIT. The four others are:
(1981) ***Richard C. Mulligan,*** *'76, associate professor of molecular biology at MIT and member of the Whitehead Institute. A biochemist who works on cancer research, he is currently developing techniques to use viruses for gene therapy on humans with genetic disorders.*
(1984) ***Michael J. Piore,*** *MIT professor of economics and management with interests in industrial relations, blue-collar manufacturing employment, and low-wage labor markets. He is co-author of* Dualism and Discontinuity in Industrial Society *and author of* Birds of Passage, Migrant Labor and Industrial Societies.
(1982) ***Charles F. Sabel,*** *professor of political science at MIT and co-author with Michael Piore of* The Second Industrial Divide. *He is studying ways in which American industry can respond to the decline of mass production and changing world competition.*
(1981) ***Michael Woodford,*** *PhD '83, professor of economics at the University of Chicago. His chief area of study has been the role of expectations in economic phenomena, focusing on the reasons why changes in expectations can be a source of instability in the economy, independent of changes in underlying, fundamental economic conditions.*

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ProNet information packages were mailed in April. If you have not received a package, please write to MIT ProNet Registration Department, MIT Alumni Association, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139. Alumni in all disciplines are invited to participate in the program.

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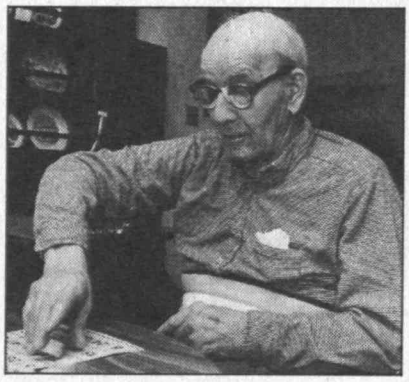
CLASS NOTES



He feels "fine and dandy" at 105. John Bradley, '07, enjoys a game of Bingo at the Adams House nursing home in Torrington, Conn."I have lots of good friends around here," he says. Bradley began his career as a metallurgist for the American Brass Co., where he won much recognition, retiring at age 72. He celebrated his 105th last February with a message from President and Mrs. Bush, a visit from Mayor Delia Donne, and cake and hors d'oeuvres. We wish him many happy returns.

16

A few months ago, I started searching for a copy of classmate **Rusty White's** book, *The Combined Gospels of Matthew, Mark, Luke and John.* Recently, I borrowed a copy from my local library. They were able to get it from the Boston Public Library. It is a very helpful compilation of scripture in which Rusty highlights dominant themes, parables, messages, events, sermons, etc. and then records for each of these the comparable verses written by each of the authors of the four gospels. For example, on the subject of the resurrection of Jesus, he records the chapter, verses, and the scriptural context of the account in Matthew, Mark, Luke, and John. This makes it very convenient for the reader to have in separate sections the thoughts and words of each gospel writer on the important stages of the public life, death, and resurrection of Jesus Christ.

Dina Coleman had requested my help in locating this book. Since I didn't have the pleasure of meeting Rusty, I asked Dina to tell me more about him. Dina's response, in part: "Rusty was a remarkable person. He was a member of Delta Tau Delta fraternity and was very active in extra curricular activities. After graduation, Rusty worked in many fields including a short period as professor of mathematics at the University of Washington. He was adverse to what he called the daily grind. He would visit classmates throughout the country. Once when I was in Louisville, he was lecturing on "The Great Pyramid in Egypt." He predicted the second world war and the cold war following. He and his wife retired to a log cabin in the White Mountains of New Hampshire and worked on the gospels book. He died there of a heart attack." Rusty died in his early fifties in 1949. My personal recollection of him was found in the great admiration, respect, and love that so many of his classmates had for him.

Dina also writes: "As for myself, very little has happened since I last wrote to you. Coming up in July is a trip to Pittsburgh from Cincinnati on the Mississippi Steamboat." Keep writing, Dina, it's always a pleasure to hear from you.

We regret to report the passing of **Frank G. Darlington,** who was a 1914 graduate of Princeton University, the first in his civil engineering class. And he earned a bachelor's degree in electrical engineering in 1916 from Harvard and MIT when the two schools were combined. May he rest in peace.—**Bob O'Brien,** acting secretary, 25 Keith Rd., Pocasset, MA 02559

18

As can be expected of a class now graduated from MIT 72 years ago, there are not many of us here to supply news for these columns. I can report, however, that I attended a lecture April 25 by MIT Professor Lester Thurow. He predicts that in the near future the most powerful economic power in the world will be the new nation arising from west and east Europe.—**Max Seltzer,** secretary, North Hill, Apt. B403, 865 Central Ave., Needham, MA 02192

19

We note that members of the class of 1915 are celebrating their 75th reunion. We will match you later, but for now we congratulate your wonderful class.

We go to press without any bad news; the class of 1919 is "just rolling along." We tried to contact classmates whom we have not heard from for a while by telephone, but alas were not able to reach some of them. Two had answering services, and we haven't heard back from them yet. And, the phone of a third was temporarily disconnected. But we shall try again. Maybe they are away on a cruise "just rolling along!"

We did reach Erma and **Doc Flynn** and found them both well and active. Erma inquired about my wife, Florence, whom she met at Pops while at our 65th reunion. Doc still enjoys his daily walks, and because the stores are close to their home, he helps with the shopping. They do not need a car. They may not have it in mind, but they are cooperating with those concerned about the greenhouse effect. We enjoyed this telephone call with such nice people.

We also talked by telephone with **Don Way.** Don is making the best of old age and enjoying it. He and his wife, Barbara, are keeping busy—playing golf and visiting their family and friends. I think they are getting ready for their 75th reunion.

And so let us all look forward to the good summer ahead.—**W.O. Langille,** secretary, P.O. Box 144, Gladstone, NY 07934

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Our class continues to be outstanding in contributions to the Alumni Fund; we have 47 percent participation. Congratuations!

U.S. Navy Captain **Joseph McGuigan** of Alexandria, Va., died last December. He leaves a daughter. . . . Major General **Lyman P. Whitten** of Perrine, Fla., died last September. He leaves his wife, Olive. . . . **Mrs. Mildred Coombs** of Bremerton, Wash., died in October. A memorial service was held in New Hampshire, and she was laid to rest in Concord, N.H. She leaves her husband, George L. Coombs.

Since this writing (early May) is before Technology Day, I hope to report about it favorably in the next issue.—**Harold Bugbee,** secretary, Country Club Heights, Apt. 313, 3 Rehabilitation Way, Woburn, MA 01801

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There are three classmate deaths to report this issue: **Elliott T. Adams** of Newton, Mass., January 3, 1989; Colonel **Franklin Mitchell** of Bridgewater, Mass., on February 26, 1990; and **Edward P. Wylde** of Naples, Fla., on January 7, 1990.

Elliott Adams served in World War I. Besides an SB from MIT, he earned a PhD from Harvard, majoring in biochemistry. He taught chemistry at the Harvard Dental School and biochemistry at the University of Georgia and later at Tufts Medical School. He retired in 1955, and his great interest became educational philanthropy. he established two professorships, one at New York University and the other at Harvard Medical School.

Franklin Mitchell served in the U.S. Army and retired as a colonel in 1947. He was an active trustee of the Bridgewater Public Library.

Edward Wylde died in Vermont, where he had been in a nursing home since last September. He was founder and president of the former Harbor Machine Co. and a former member of the Williamstown Planning Board. He also served in World War I.—**Sumner Hayward,** secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden,** assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

These notes are being written in May for publication in the August/September *Review.* It seems appropriate that our class acknowledge with thanks, albeit belatedly, the generous gesture of the Alumni/ae Association in April inviting us and the other classes prior to 1925 to attend the Technology Day luncheon as guests of the Institute. While only a small number of us (my guess) were able to accept, nevertheless the recognition of us old codgers helps to keep our spirits up and our flags flying.

Sorry to report the deaths of **Philip M. Hastings, Wallace L. Howe,** and **Samuel H. Reynolds.** Hastings, Course II, died December 16, 1989, at age 89 in Gaithersburg, Md. He retired in his 60s

PHOTO: JOHN MURRAY

as plant engineer at Lever Bros. Baltimore plant. He is survived by his daughter, Mrs. Miriam B. Hyde of Phoenix, Md. Howe, Course IV, died January 4, 1990, at age 91 in West Boylston, Mass. At the time of retirement in 1963, he was corporate vice-president of research and development at Norton Co. in Worcester, where he spent his entire professional life for 40 years. He is survived by a son, Alan F. Howe, of Princeton, Mass.; a daughter, Carol H. Hagan, of West Boylston; six grandchildren; and seven great grandchildren. Reynolds, Course II, died January 26, 1990, in Carmel, Calif., just one month short of his 91st birthday. He entered Tech as a junior after two years at Cornell. He had a long and successful career in the steel industry: sales manager for Crucible Steel Co., living in Boston, Atlanta, and Youngstown, at midlife, vice-president of sales for Great Lakes Carbon Co. of New York City from which he retired unwillingly at age 70. In retirement, he first lived in Madison, Conn., then went West to finally settle in Tiburon, Calif., after his wife, Elizabeth Ann Hill, of Boston, died. In 1983, he moved to Carmel Valley. Sam was an active alumnus: past president of the MIT Club of New York and a regular attender at our five-year reunions and at many of the intervening Alumni Days. He is survived by one sister, Susan Pesko, of Westport, Conn.; his son, Clarke Reynolds, of Tiburon; a grandson; a granddaughter; and three great-granddaughters.

As this column was going to press, we learned the sad news that **Parke D. Appel** died last June 7 in Florida.

Our condolences are extended to the families of these deceased classmates.—**Yardley Chittick,** secretary, Rt. 1, Box 390, Ossipee, NH 03864

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By the time this reaches you, Technology Day will have passed. Your secretary was unable to attend. It is hoped someone will send news about those who attended.

Bill LaLonde reports that **Leander Poor** passed away last April 15 of a heart condition. Leander and his wife, Mary, had three children. Following graduation from MIT in civil engineering, Leander worked with Pennsylvania Railroad until 1945 when he became associated with Ford Bacon and Davis, Inc., until 1966. He then joined Louis T. Klouder and Associates until 1969. His hobbies were "paying bills, gardening, and keeping Mary happy."

Word has been received from Mary C. Heather that her brother, **Salvatore A. Guerrieri,** passed away last February 21. Salvatore graduated with our class in chemical engineering. In 1932, he received a masters. He was born in Malfi, Italy, and lived in Flushing, N.Y., before moving to Stockbridge, Mass. A few of his vocations and locations are: assistant professor, Division of Chemical Engineering, University of Delaware; General Electric Co., Pittsfield; New York National Aniline and Chemical Co.; U.S. of Standards; vice-president of Arthur Molte and Co., Cleveland, Ohio; lecturer at George Washington University; research associate, MIT; and many others. He was married to Mary E. Cady of Ypsilanti, Mich. She died in 1981.

Joel Yowell Lund died last March 5. He received an S.B. in business and engineering administration. During his undergraduate years he was an official of the Rifle Club and a member of the Athletic Association. He married Erle Hall Harsh of Nashville, Tenn., and they had two daughters and four grandchildren. After graduation, he became assistant superintendent of Lunder Williams Shoe Co. and an industrial engineer for International Shoe Co. Following that, he became an official of several companies. He became interested in the local school board and became its president. Memberships in prestigious clubs were many. He also was awarded the degree of honorary doctor of science by the St. Louis College of Pharmacy. His hobbies were golf, travel, stamp collecting, and charities promotion. Upon retiring, he and his wife visited every continent and were impressed by the differences in people. They traveled through 14 countries in Africa, studying possible ways various people could live together in the future.

Fellows, you are still batting around the zero mark. Let's raise the average a little.—**Frederick O.A. Almquist,** secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

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Hats off to Colonel **I. Henry "Hap" Stern,** co-secretary of the class of 1924. Col. Stern was featured in an article entitled "Fighting For the Environment," published in the January 21, 1989, issue of *Palm Beach Daily News.* According to the article, Colonel Stern became active in conservation and ecology when he arrived in Palm Beach in 1966. As vice-president of Save Lake Worth he was instrumental in getting laws passed that prohibit dredge and fill projects in his area. He served on the Palm Beach Zoning Commission from 1972 to 1988, for five of those years was chairman. The result of those years of hard work is a strong zoning code that protects the island's quality of life. Colonel Stern has lived by the creed, "Moderation is best." The rule he taught his three children and eight grandchildren is, "Wherever you go, leave that place the way you found it or a little bit better."

Don Moore writes from Los Gatos, Calif., that he is basking in the achievements of his daughter, Sandra M. Faber, BS, PhD, DSc—as the ramrod of the "Seven Samurai," she and her colleagues set the world of astrophysics and cosmology on its head with their discovery of the "Great Attractor," which upsets the longheld theory of a uniform distribution of matter following the Big Bang. She is deeply involved in the Hubble Space Telescope and the 10-meter Keck Telescope now under construction in Hawaii. In April she delivered the Feshbach lectures at MIT's Physics Department.

I just received word of the passing of **Donald G. Bertch** of Bradford, R.I. Mr. Bertch was treasurer at the Stillwater Worsted Co. in Harrisville for many years. He was the husband of Mary (Burney) Bertch. He is also survived by two stepdaughters, Carol Lorden and Jane Carter. . . . **Julian A. Joffe,** of Gainsville, Fla., was 87 years old when he passed away in February. He was the retired owner of J.A. Joffe and Co., a confectionery manufacturing firm in Mt. Vernon, N.Y. In addition to earning his degree at M.I.T., Dr. Joffe earned a Ph.D. in sociology from the University of Florida when he was in his late 70s. He was the author of two books on sociology, *Studies in the History of Civilization* and *The Evil Empire: Neo-Mercantilist Russia.* He also published numerous scholarly articles. He is survived by his wife Sara, two sons, two daughters, twelve grandchildren and seven great-grandchildren. A donation in Dr. Joffe's name may be made to the Village Helping Hand Fund, 2803 N.W. 83rd St., Gainsville, FL 32606.—Co-secretaries: **Katty Hereford,** Hacienda Carmel, No. 237, Box 5297, Carmel, CA 93921; Col. **I. Henry Stern,** 2840 S. Ocean, No. 514, Palm Beach, FL 33480

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Wen Tsun Chang, who lives in Shanghai, China, wrote to **Courtenay Worthington,** saying that he had given considerable thought to the possibility of attending the 65th reunion, but due to his age he decided it would involve too long a journey. Chang is emeritus professor of heat-power engineering at the China Textile University. He sends greetings to all classmates, and specially mentions **Y.H. Ku,** who was a classmate at Tsing Hua College. . . . **Fred Greer** writes that after nearly a year in New England, he and Eleanor are heading back to their apartment in Naples, Fla. One of his two factories recently moved from Massachusetts to New Hampshire, which in part accounts for their spending most of last winter in New Hampshire. Fred is terribly disappointed that he had to miss the reunion.

It is with sorrow that the passing of four classmates must be reported. **Frank W. Preston** died at his home in Stonington, Conn. on February 7. Before his retirement, he was manager of technical sales for Mt. Hope Machinery Co. of Taunton from 1956 to 1971 and was plant engineer for the New Haven Board and Carton Co. from 1935 to 1956. Frank was a life member of the American Society of Mechanical Engineers and was a past president of the New Haven Chapter of the ASME. Frank is survived by his wife Melinda, one son and one grandchild. . . . **Francis J. Mulcahy** died on January 12 at the Holy Family Hospital in Andover, Mass. Frank worked as an electrical design engineer for the U.S. government and for several companies in the Boston area. He is survived by a son and two grandchildren. . . . For many years we have had no address for **Richard F. Hayward,** but the Alumni office has recently learned that he died in July 1983 at Bluemont, Va. . . . Douglas B. Martin died in Farmington, Mich., on January 19.—**F. Leroy (Doc) Foster,** secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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I'd like to have many of you write to me about the things you're doing. . . . I called **Ben Margolyn** to get up to date on his activities. He is still selling autistic walls to some degree. These movable walls are hung so that they can be moved for enlarging an office for a meeting. . . . I talked to **Ben Levis** to find out if our Olympic champion was still active. He is putting in considerable time helping the company to which he sold his old business. He advises on their stone and marble flooring and installations bidding. Ben and his wife Yvonne are still taking ballroom-dancing lessons, so they can compete successfully all over the country and in England. Let's hear from some of you who are still active.

Alonzo W. Ruff of York, Pa., died March 21 at his home after a long illness. He was with St. Onge, Ruff and Associates as vice-president and later as chairman. He held more than 60 patents and was listed in Who's Who of the East, Who's Who in Finance and Industry, and Who's Who in Engineering. He leaves a son, four daughters, 11 grandchildren, and a sister. . . . **Ezra D. Trumbull** of Crestview, Fla., passed on June 9, 1989. I am sorry I have no information on his life other than he was living in Hampton, N.H., recently.—**Donald S. Cunningham,** secretary, 27 Lowell St., Braintree, MA 02184

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Robert G. Dexter of Lunenberg, Mass., writes that having retired after 45 years with Barkley and Dexter, Inc., his present interests are oil painting, musical composition, wood carving, swimming, and the yearly disposal of 99 billion oak leaves. Bob formed his company soon after leaving MIT and became a specialist and a "Rube Goldberg" inventor of automatic machines for industry: packaging, bottling, you name it. They helped mechanize the industrial U.S. Bob was also known as the sweet saxophone player of the jazz band at MIT.

Shirley Damon, widow of **Edward Damon** of Bartlesville, Okla., wrote about an invitation she received to the Cardinal Gray functions of alumni week in June. She says, "I appreciate your invitation, but without my dear husband, who died in June 1988, I could not possibly enjoy the excellent program. MIT has many happy memories for me—a dance at Walker, many parties at the Theta Chi house while Ed lived there, the Tech Show when it came to Northampton, and our son's

MIT commencement in 1952."

Several members of our class have passed on. **Charles H. Kingsbury** of Deland, Fla., died on September 11, 1989. He was a mining civil engineer and superintendent with Rosario Mining Co. in Honduras in 1955. The mine produced 250,000 ounces of silver a month. He retired to West Palm Beach in 1959. He subsequently moved to Deland where he was a member of the Orchid Society and the Sons of the American Revolution.

Daniel E. Sullivan died on September 16, 1989, in Bronx, N.Y. He retired in 1967 as sales engineer for Westinghouse in New York City, having been with the company since graduation. He was recruiting students for his company from colleges in New York. He was a president of the Dynamic Speakers Club. Dan will be remembered as the leader of the Techtonions at MIT. Musical Club members will remember many hours dancing to his music after concerts. I received a nice note from his widow, Rose, that Dan was very proud of the Institute.

Samuel A. Kaswell of Tamarac, Fla., died on January 5, 1990. A chemical engineer, he was superintendent of Fabric Chemicals Corp. in 1933 in Jersey City. He was also superintendent and became president and manager of Chemitex Manufacturing Corp., makers of textile detergents and finishes in Passaic. Sam retired to Florida and in 1987 reported he was quite well and active. He played golf occasionally, swam, and rode a bike daily. He was also active with the Ft. Lauderdale Alumni Club.

William Engs of Chatham, Mass., died on February 25, 1990. A native of Piedmont, Calif., he received a BS from Berkeley in 1924, then an SM in chemical engineering at MIT in 1927. He was with American Cyanamid Co. until 1963, then became vice-president of Stauffer Chemical Co. in New York City. He was a consultant for Occidental Co. and also served in the International Executive Service Corps for Libya and Peru. He moved to Chatham in 1969 and was a member of Chatham Retired Men's Club. He was a former member of Manursing Island Club and American Yacht Club of Rye, N.Y.

Leslie J. Weed of Wellesley died on March 3, 1990. With an MS in electrical engineering, he joined Boston Edison and became a leader in this field, retiring after 41 years' service. He became head of the Distribution Division and later head of the electrical engineering section. His last position was staff consultant to the Engineering and Construction Department. Les was best known as section chairman of the American Institute of Electrical Engineers as well as president of Engineering Societies of New England. He was on the National AIEE Committee on Transmission and Distribution. In addition, he taught evening school at Wentworth Institute and Northeastern University. Les was also an accomplished artist specializing in oil painting. He was a member of Copley Art Association, Rockport Art Association, North Shore Art Association, and New Hampshire Art Association. He was certainly a full-time professional who made time for artistry with numerous accomplishments in both fields.

We offer our condolences to the widows and families of these fine classmates.—**Lawrence B. Grew,** assistant secretary, 21 Yowago Ave., Branford, CT 06504

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Undoubtedly many of you saw the full page "Donor Profile" in the May/June issue of the *Review* wherein Elsie and **Homer Burnell** were featured as the profile couple. Their photograph was one of which they should be pleased and proud. It was heartwarming to learn more of their loyalty and outstanding support to our beloved MIT. To you, Bunny and Elsie our hearty congratulations, and thanks for setting us all such a splendid example. . . . We were pleased to learn of a three-day reunion of Ruth and **Ed Ure** with Anne and **George Palo.** The rendezvous took place at a motel in Roanoke, Virginia where they discussed just about everything of any consequence. After spending most of their married life in Knoxville, Tenn., the Palos are planning to move and settle in Rochester, Minn. The change of address has been scheduled for late May 1990. . . . In the November/December issue of the *Review* on page MIT 29 you will find a brief but highly interesting report on **Abe Woolf** and his work in the field of architecture. We were especially interested to learn that Abe had established a fund to support a lecture series on "Design of Constructed Facilities." Further lectures were planned to become a part of a curriculum for structural studies. Abe's son, Steve, is also an architect (MIT '66), but grandson Jason left that family pattern and went into electrical engineering (MIT '86). Our congratulations to Abe and to all of his competent family. . . . **Fred Lewis** has informed us that he and Janet were planning to attend a good part of the Technology Day program along with the associated special events for the Cardinal and Gray Society. We hope and expect to have our usual strong turnout of '28ers.

It is with deep regret that we must report the deaths of the following three classmates. **Jacob Berkover** died on February 16 following a long illness. Jacob graduated in Course 17, building engineering and construction. He studied also at George Washington University, where seismographic geophysics was his major subject. He made his professional career with the Massachusetts Department of Public Works, where he was district highway engineer for 50 years with major highway design responsibilities. Wife Helen predeceased him; they leave a son, Robert. . . . **Lewis S. Coonley** died March 10, 1990, in N. Fort Myers, Fla. Lewis received his BS at Rensselaer Polytechnic Institute, joined our class to earn an SM in chemical engineering, then returned to Rensselaer for a doctorate in chemical engineering. His whole career was devoted to teaching chemical engineering at Rensselaer whence he retired as head of his department. Besides wife Dorothy, he leaves his daughter, Leah, and son, Lewis Jr. The latter was very thoughtful in providing to us the foregoing information. . . . **Edward H. Holmes** died February 15, 1990, while hospitalized and after a long illness. Ed graduated in Course 1, civil engineering, then received an MS in civil engineering from Harvard. His entire professional career of 43 years as a civil engineer was with the National Bureau of Roads, Washington, D.C. He retired as associate administrator of the Bureau in 1971. Ed leaves his wife Elizabeth, sons Joseph and David, two grandchildren, and a great-grandchild. To the families of these, our departed classmates, we extend our heartfelt sympathy.—**Walter J. Smith,** secretary, 37 Dix St., Winchester, MA 01890; **Ernest H. Knight,** assistant secretary, Box 98, Raymond, ME 04071

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Robert S. Pride and wife Marian, who have had a close relationship with your secretary and wife Helen over the past 60 years, invited us as their guests to attend a dinner meeting of the MIT Club of Palm Beach County on January 20. Conversely, the Prides joined a number of our friends to celebrate Easter together at our home. . . . **E. Neal Wells,** of Pinellas Park, Fla., who attended our 60th reunion at MIT in fragile health accompanied by his son, is making a good recovery. . . . I received an Easter Card from **Paul Donahue** and his wife of Nahant, Mass., with a note: "It is such a pleasure to hear from you and to know that all is well with you. We had two short trips to California and some weeks in Naples, Fla., visiting Paul's sister. We had a letter from Mary and **Arnold Conti.** They have sold their condo in Atlantic Beach, Fla., and are moving into a nearby life care complex (military) where they will enjoy the company of Navy friends. We are still enjoying life in our old homestead in Nahant with rooms for family and friends to visit. Our grandson is a senior at MIT and very active in the Musical Theatre Guild. He has taken the part of Professor Higgins in 'My Fair Lady.'"

From **Samuel J. Shaffer** of Los Angeles, Calif.: "Sorry to report that my wife, Sybil, died suddenly last Mother's Day, after 62 years of happy marriage. My health is good and I am still active in my field. I have a new great-grandson, Alex. I am treasurer of our retail computer society, and I am on the advisory board of the Retail Institute of California State University, Los Angeles. I am planning to attend the Technology Day programs in June." I met Sam and Sybil during our 45th and 50th reunions. He has been a loyal member of our class and MIT. This being a non major reunion for our class, there will be few '29ers attending. I telephoned Sam and expressed my condolences for his loss on behalf of the class of 1929, and I learned from him that **Joseph L. Speyer,** our class treasurer, and **David H. Wilson** are among his friends in the Boston area. I promised to be present on Friday's activities and have asked Joe and Dave to join us. I regret to announce the following deaths of our class members: **Malcolm L. Mosher** of Marshfield, Mass., in December 1987; **Hazen E. House,** of Knoxville, Tenn., on November 17, 1989; **Clarence E. Worthen, Jr.** of Orleans, Mass., on January 18, 1990; and **B. Clark Boeckeler,** of Concord, N.H., on January 28, 1990.

B. Clark Boeckeler graduated from Harvard in 1927 and received an SM degree from MIT in 1929. He worked at the Lummus Co. in New York City, eventually becoming manager of the chemical division. He retired from Kennametal, Inc., of Latrobe, Pa., in 1971, where he was research director. He was engaged in research and development during most of his professional life. He is survived by his wife, Martha; two sons, William C. of Madison, Conn., and John C. of Concord, N.H.; and a stepson, Captain Edwin A. Shuman, III, U.S. Navy.—**Karnig S. Dinjian,** secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364, (603) 926-5363

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This month we have an update on my efforts to identify our youngest survivor. In the April 1990 Notes I suggested that **Mo Shaffer,** born in February 1910, held this record. In the July issue I noted that **Win Hartford** was born in June 1910, i.e., later than Mo. I now have a letter from **Sol Uman** in Pompano Beach, Fla., calling my attention to the fact that he was born in August 1910 and thus appears to hold the "juniority" record for the class of '30. Can any of you beat this record? Sol says he was worried that as a 19-year-old MIT graduate he might be considered too immature by prospective employers and hence arbitrarily advanced his age by one year on his job applications.

John Hanley writes from Omaha, Neb., that his wife Grace passed away in 1985. His retirement activities include "golfing, fishing (trout), travel, and much reading." . . . From Wellesley Hills, Mass., **Bill Harris** reports that he became 87 in March. He and his second wife Edith live a quiet life, but go to Florida each winter and to a summer home on Cape Cod from June 1 to October 1. . . . **Ed Pritchard** and his wife, who live in Pocasset, Mass., are in "fairly good health" and travel rather extensively. They make annual trips to visit their "London family." In May they also planned to "drop over to Paris to enjoy the city, French food, take another look at the Pei Pyramid plus the new Louvre, pick up some wine and cheese for London family," and be back in time for the reunion.

Unfortunately we again have a number of downbeat items to report. . . . Mary Ann Foster writes from Penacook, N.H., and Louise Addison from Northampton, Mass., that their husbands **Bob Foster** and **Henry Addison** are now in long-term nursing facilities. The Addison's report is leavened by the revelation that last August their

granddaughter presented them with three baby girls—triplet great-granddaughters.

We have also received word of the loss of two more of our classmates: **Ed Kingsley** and **Jim George.** As most of you know, Ed has been our conscientious class treasurer for many years. My records indicate he succeeded **Joe Harrington** as treasurer in 1960. The news of his death came in the form of a telephone call from his wife Betty, whom many of you will recall having met at past reunions. Ed was born in Boston and was a Course XV major at MIT. I do not have any information about his early career. At the time of the 30th reunion he was working for the Paine Furniture Co., but shortly thereafter (1936) he founded the New England Contract Carpet Co., which he owned and operated for many years. About 10 years ago the Kingsleys bought a condo at Leisure World in Mesa, Ariz., about 150 miles north of our winter home in Green Valley, and from time to time we visited back and forth with them. Betty is planning to continue living at Leisure World, where she has many friends. Ed died March 28, about two weeks before his eighty-second birthday. In addition to Betty he is survived by a son, a daughter, and four grandchildren. . . . I only recently learned of **Jim George's** death in 1985. At MIT he used the name James George Papadopoulos, but some years later decided to drop his original surname because of orthographic problems. As of the early 1960s, he worked for the Bureau of Naval Weapons on weapons systems. After retiring from his Navy job in 1963, he taught mathematics and applied mechanics at Montgomery Junior College in Maryland.—**Gordon K. Lister,** secretary, 294-B Heritage Village, Southbury, CT 06488

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At last we have some cheerful news to start off with. . . . **Henry G. Hartwell** advises that he is now "living comfortably in Duxbury, Mass., with my 'Geisha Girl' of 53 years," but he says nothing of his activities after retirement. . . . And another, longer note from our "producer of crude petroleum" in Abilene, Tex., **Norman G. FitzGerald:** "The memories that Brownie and I have had of our good friends and good times at MIT reunions linger on—and we are looking forward to my 60th next year. I am still active in exploring for oil and gas in Texas, Oklahoma, and in eastern Canada. It isn't as profitable as it used to be, but I am still fascinated by the science and technology of the hunt. Our three sons are doing well, but none has married. Scott, the eldest, is a 'retired capitalist' in Houston, Dr. Carl H. FitzGerald, MIT '63, is senior professor of mathematics at the University of California in La Jolla. Our youngest, Texas FitzGerald, lives in San Angelo and is doing geological and computer programming for us. We are active in church affairs, take part in various community activities, and I am deeply involved in the essential work of oil-industry trade associations. As an avocation I have some minor financial interests in Costa Rica and each year take a week or more to visit in that interesting country and check on the progress. All in all we have had a very good life, but we do miss being close to New England and friends—see you all in about a year."

And a note from Elizabeth Shimmin at 618 Tattson Blvd. #839, Orange Blossom Gardens, Lady Lake, FL 32159, that **Harry Shimmin** had a fall in June 1989. His condition became worse so on June 22 he entered an excellent health-care facility (Leesburg Nursing Center, 715 East Dixie Ave., Leesburg, FL 32748). His bed is near a window in an excellent and sunny double room (Room 110A) where he can look out on the grass and flowers. This view ought to help him, the former Boy Scout worker that he was.

One individual I can't forget is **O. Whitmore (Whit) Burtner** (Course VI), who spent part of his four years at MIT on "The Tech" and the musical clubs. I am sorry he will not be with us next year. He died February 28 at South Miami, Fla. Like many of us, he apparently found engineering jobs scarce in 1931, so went off to Cornell Medical School. He served in the U.S. Army Medical Corps in the Philippines in World War II and afterwards from 1948 to 1984 practiced in South Miami, Fla. following which he retired to Appomatox, Va. He is survived by his wife, Mrs. Tove Burtner of 9159 SW 77th Ave., Apt. 114, Miami, FL 33156; a sister, Mrs. George Jacoby of Williamsburg, Va., and nephews Dr. John B. Jacoby and Dr. George Jacoby of Massachusetts. Memorial donations may be made to South Miami Hospital, Dept. of Oncology, South Miami, FL 33156.

Alexander Leo Pavlo (Course VI) is reported to have died in July 1987. He was for many years employed by the City of New York and held engineering licenses in many states. He was survived by his wife Miriam of 2765 Ocean Ave., Apt. A64, Brooklyn, NY 11229. . . . **Charles E. Larkin** (Course XV) of Winchester, Mass., died suddenly January 30 while vacationing in Puerto Rico. He served with the 331st Aviation Engineering Group USAR, Army Base Boston, retiring with the grade of major; during World War II he was with military intelligence. He was employed with the Adjudication Rating Board of Virginia, retiring after 33 years. He is survived by his wife Mary; a son, Charles E. Larkin, Jr., of Virginia; daughters Deirdre Ceglia of Rye, N.H., and Paula Blain of New York City; and a brother, George V. Larkin of Washington, DC. . . . Our condolences to all their survivors.

And an item recalling the good people do—the chair our **Ken Germeshausen** established and which was formerly held by Professor Emeritus Jay H. Forrester of the Sloan School of Management, has been awarded to Dr. Robert S. Langer, a biomedical engineer recognized internationally as a leader in the development of innovative treatment delivery systems across a broad medical front. Professor Langer has been a member of the MIT faculty since 1978, and was awarded a doctor of science in chemical engineering at MIT in 1974.

The following note was received from **John Swanton:** "A meeting for representatives for all classes holding reunions in 1991 was held April 25 by the Alumni Association Staff, at the Bush room, 10-105. This was for all classes, not just ours.

"**Dick Ashenden** and I planned to attend, and he called **Randy Binner,** our president, who came all the way up from Connecticut for the occasion. Louise went, too, so we had a good 1931 group and it was a very helpful meeting. Randy is going to call **Ed Hubbard** when he gets home from a trip to see if he will head up the Class Gift activity, by no means as extensive as the 50th, of course. After all, we're getting older, but we can still hold our own.

"A general mailing to all class members goes out in September, taken care of by the Alumni Office. The second mailing is mid-October, at which time we should have our committee together, and a program and preliminary budget worked out. So we plan to have a first regular meeting in early October, or before if we can arrange it.

"Recapping personnel: Dick Ashenden and John Swanton, Co-chairs; Randy Binner, president, Ed Hubbard, Class Gift; Ben Steverman, treasurer; Wyman Boynton, secretary, and **Howie Richardson.**"

Other possible suggestions were: **Art Fuller, Shel Smith, Harold Davis** (Chelmsford), **Gene Branca** (Jamaica Plain), **Hank Allbright** (Quincy, or is it Maine?), and **Chuck Turner** (Marblehead). We welcome any volunteers. The jobs are not as difficult as before; the Alumni Association staff now efficiently takes care of many of the things class members formerly had to do (transportation, planning, and logistical support).—**Wyman P. Boynton,** secretary, 668 Middle St., Portsmouth, NH 03801

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I had the pleasure of seeing "Ice Chips—Show of Champions" presented by the Skating Club of Boston. There I saw **John Brown,** made up as a clown, skating merrily along in the chorus line.

Don Severance, '38, informed me that John was elected as an honorary member of the Skating Club of Boston in March 1990. Don made the introductory remarks from which I excerpt the following: "After John's retirement from Badger, the company constantly called on him to handle difficult technical problems they encountered overseas—at a time when many companies were actively seeking the early retirement of employees in the 55-to-60 age bracket. In the World War II records of the alumni you will find, 'Brown, John J., '32, lieutenant colonel, USA, July 1942—August 1946, Bronze Star Medal.' Let's look into that. Recall, he's only nine years out of MIT. His first military assignment was unspectacular: Edgewood Arsenal in Maryland—but then two and a-half years in Calcutta, India. That's where the Bronze Star comes in. And why Calcutta? The Army Corps of Engineers had to construct a gasoline pipeline network: India, Burma, China. John's roles: from engineering officer to executive officer and then commanding officer of the India-Burma Pipepline Detachment. His job: planning and supervising both construction and operation of a line eventually handling well over four million gallons of gasoline per day. Not only was he cited for his initiative, tact, and foresight in getting critical supplies practically unavailable in India but also for incorporating substitute materials and, more than that, substitute procedures. John was the individual 'directly responsible for its completion well before target date' and the subsequent operations 'proved the sound engineering skill employed in this project.'"

Over the years, John has served the Skating Club in many ways—board of governors, as judge in many contests, as star ticket salesman (450 tickets the year Dorothy Hamel won the Olympics), and once when there was a serious problem in keeping the ice in good skating condition. John was instrumental in correcting the problem at expenses the club could afford.

Arthur Marshall has returned from a month's stay in Israel (his 49th trip). He attended military and business conferences. He consulted with many Middle East leaders, including Mayor Teddy Kolleck of Jerusalem, Elias Freij, the Christian-Arab mayor of Bethlehem, and Foreign Minister Moshe Arens, '47. Arthur is still hopeful that a constructive peace will emerge.

Thomas H. Anderson, a retired chemical engineer, died after a period of ill health in February 1990. Before retirement, he had worked for 26 years with C.F. Braun & Co. He had been active in civic and church affairs. His wife, Ruth, died in 1981. He is survived by a daughter, three sons, and seven grandchildren.

Francis R. Smith, 91, died in February 1990. He was a lieutenant during the war. He was co-owner of the Fraen Machine Shop in Wakefield, Mass. Preceding him in death were his wives Helen Hegel and Hesler Copeland.

Donald K. Morgan died in February 1990 in St. Louis, Mo. Before retirement, he served many years as project engineer for the Aney Conveyor Co. He is survived by his wife Vivian, two sons, two daughters, and four grandchildren.

The Alumni Association informs me that **Edward Stevens, Jr.** died May 1978 and **Don Eustace Corson** died December 1989. When I receive more obituary information I will print it. Again, may I remind you, please write and send pictures.—**Melvin Castleman,** secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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George Seavey died January 11 in Lynnfield, Mass. His career was with Eastern Gas and Fuel,

Mitre, and Viatron. . . . **Beau Whitton** died last April 24. As most of you know, Beau was our class secretary for many years, having succeeded **Warren Henderson**. Whitton's adult life was spent entirely in Charlotte, N.C., during which period he ran a very successful construction outfit, remained true to the spirit of scouting (where he was an Eagle Scout), helped Blacks to receive assistance toward higher education, was chairman of the Charlotte City Planning Commission, helped draft its master plan, zoning laws, and other civic matters. He is survived by two daughters and a son, Robert Whitton, of 2626 Shorewood Ave., Charlotte, NC 28207. . . . **Eugene B. Williams,** of Dearborn, Mich., died February 12.

Norm Spofford, now in Pensacola, spends a lot of time helping friends in Taiwan with English and traveling in mainland China and southeast Asia. . . . **Harry Summer** enjoys visiting his grandchildren in Washington, D.C., and Carmel, Calif; he plans a second retirement in Evanston, Ill. . . . **Bob Heggie** is chairman of the town budget and finance committee, president of the Civic Association, and president of his cooperative in South Palm Beach, Fla. . . . **Melville Ehrlich,** of Cranbury, N.J., lost his wife of 54 years, whom he met while he was at Tech. He still consults on his long-term specialty, lubricating greases.

Some classmates have written very informative and necessarily long letters. Your secretary will be delighted to send any classmate full copies of these communications on request.

Ellery Clark sends a long letter from Yucaipa, Calif., including news of surgery, South America, and Western Canada. . . . **John Wiley** of New York, N.Y., writes a long letter from Amsterdam; he apparently spends much time in the Netherlands. . . . We also have a long interesting article about **John Brookfield,** inventor of the (Ditto) Viscometer, available on request.—**William B. Klee,** secretary, Box 7725, Hilton Head Island, SC 29938, (803) 785-7746

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I'm afraid I owe you all an apology for the dearth of '34 notes in the last few issues, especially those of you who responded with notes on your Alumni Fund contribution envelopes and must be wondering why your news wasn't published. Let me just say it has been a busy spring. My wife claims I've become a world-class procrastinator. But there are a number of class losses—let me take some of them first and then go on to more pleasant things.

I have word of the death of **John Barrett** of Chevy Chase, Md., in April 1987. He was listed in the *MIT Alumni Register* as having been a staff specialist in the office of the Secretary of Defense at the Pentagon. . . . Another loss about which I can tell little is that of **Albert Talbot,** who died in San Antonio on May 15, 1989. He is survived by his widow, Maxine.

On October 26, 1989, **Graves "Bud" Snyder** passed away in Summit, N.J. He had spent his career in the Air Force, both as a command pilot and in the field of communications. During his years in the service, he received a master's from Stevens Institute of Technology and an MBA from the University of Chicago. He had retired as a colonel some years ago from his last assignment as professor of air science (AFROTC) at Newark College of Engineering. He and his wife, Margaret, were faithful "reunioners" including some of the "minis" but had missed the 55th because of bad health. Bud was a longtime member of the '34 Sunday morning ham network that calls around New England.

Also in October, we lost **Daniel Mitchell,** who lived in Sun City, Ariz. He had served in the U.S. Army from 1941 to 1945, retiring after the war as a lieutenant colonel. His later career was spent with the Du Pont Chemical Co., working in engineering and as an accounting superintendent. He had been active in Rotary International and the Sons of the American Revolution. Mitchell is survived by his wife, Dorothy, a son and daughter, nine grandchildren, and four great-grandchildren.

Angelo Iantosca died in Amherst, Mass., on December 9, 1989. He had been with the State Department of Environmental Quality Engineering for 27 years and was head of the Amherst DEQE office when he retired in 1982. Iantosca is survived by his wife, Marietta, two daughters, and three sisters.

The last loss I have to report is that of **Louis Frank,** of Chestnut Hill, Mass., who died January 16, 1990. He had majored in aeronautical engineering. With a reserve commission, he volunteered for active duty in 1941, before the start of World War II. He was assigned to the Material Command and stayed in the Production Division all during the war, leaving the service as a lieutenant colonel. In 1949, he founded the L.K. Frank Co., an advertising agency that specialized in marketing for high-tech and industrial companies. The company grew with the Route 128 complex of companies and became the leading industrial agency in the area. In 1974, Frank's company was acquired by a large consumer advertising agency. After the company sale, Louis was active in mergers and acquisitions of high-tech companies.

He was active in the Jewish Family and Children's Services for many years. He was also a former Brandeis Associate, a member of MIT Dome Associates, and the Stein Club. Over the years he had attended many of our class reunions, including our 55th in 1989. Louis leaves his wife, Frances, a son and daughter, four grandchildren, and three sisters.

To the families of those who have suffered these losses, I express the condolences of the entire class.

In a somewhat happier vein, **Walter Bird** writes, "Enjoyed the 55th except for foggy weather on the Cape. Left Boston early to see my twin grandsons graduate from Dartmouth. Our home is in Sarasota, Fla., but we spend summers at our cottage on Lake Erie—the best of both worlds! As I am an adjunct professor in the Department of Architecture at SUNY, Buffalo, I get up to lecture on my favorate subject—light weight fabric structures—several times a year."

Harold C. Leighton, writes from Cape Elizabeth, Maine, "My wife died in June 1989, and I have moved permanently from Ohio back to my roots, Massachusetts and Maine. I am adding an addition to and have had my summer home winterized for permanent residence here where the ocean air is fresh and clean and wonderful."

A note from **Bob Jordan** tells of more moving, only this time not so drastic. He says, "After 43 years in one home, Nellie and I have sold the house at 20 times our cost (good Course XV management), and we are moving to a nice apartment in a new retirement community in our same city. Our new address is 33 Dogwood Lane, Northampton, MA 01060, same phone: (413) 584-8674."

Edward Sieminski writes, "Retired from Grumman Aerospace for 12 years now. Still a New York resident. Passionately interested in geo-politics and complementary medicine. Extensively traveling to New Bedford and Oxford, Mass., the fading sites of our original family homesteads. But now our family center-of-gravity has shifted to Fullerton, Calif., where the new Sieminski generations are a pride and joy."

Don't jump to conclusions with comments about when people retired—some of us are still at it. From **Theodore Steinberg** comes: "I still have a full-time practice in opthalmology here in Fresno. I am also a clinical professor at the University of California Medical School in San Francisco, chairman of the Opthalmology Section of the American Medical Association, and a consultant opthalmologist at the V.A. Hospital in Fresno."

I have a couple more items that I'll save for the next notes—I've gotten wary of the feast-or-famine input of news.

Let me finish off with a little class business. **John Hrones** was elected first vice-president at the last reunion and steps up as president following **Walt Wrigley**'s death last year. Also, **Carl Wilson** is back in business as reunion chairman and is planning another mini-reunion for this September 25-28. We expect to go to the King's Grant Inn, a very pleasant, well-set-up motel in Danvers, Mass. This is on the north side of Boston and, apart from the good company we will have, it is on the doorstep of Salem, Rockport, and Gloucester. This offers great opportunities for art, history, and museum browsing. So make a note of the dates and plan to join us. At the moment, I can't say just how it will be publicized, but if you are attracted and don't hear anything directly, contact **Carl Wilson,** 48 Druid Hill Rd., Newton Highlands, MA 02161.—**Robert M. Franklin,** secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull,** assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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Elizabeth Haskins in a brief note through the Alumni/ae Office advises she is going to relocate in Albuquerque, N.M., sometime in May. . . . **Sam Brown** spent the last week of April in Orlando with the **Gilberts, Moffatts, Lindenmeyrs** and **John Austin Cross** and his wife. ("Mo" Cross was at MIT for only our freshman year). Then Sam went on to the Poconos and was planning to arrive at McCormick Hall Wednesday afternoon, June 6.

Bernie Nelson did some traveling this past February and March. He flew from Boston to Honolulu and spent five days visiting with Cele and **Ed Taubman,** who were staying at the Kehala Hilton. They spent the afternoons relaxing and swimming in the pool and went out to dinner in the evenings. Then Bernie flew to Aukland, New Zealand, and Christ Church, where he joined a group for 16 days motoring the North and South Island. In mid March, he flew back to Honolulu for five more days at a hotel across from the beach. He ended up with a great tan, arriving home to find mail that took him two weeks to work through.

As of right now, May 8, there is very little chance of my being able to make our reunion in June due to conditions at my place of business. The fix that we are working on will not be taking place until late June, and I must stay and hold the fort. I shall rely heavily on you who were there to write to me and tell me all about it. Don't wait for somebody else to write, please take pen to hand *now.*

I have just received a belated report through Sigma Chi Fraternity that **Buckley Crist** died in August 1977. His widow lives at 73-B Lelard Ave., Plainfield, NJ 07062.—**Allan Q. Mowatt,** secretary, 715 N. Broadway, 257, Escondido, CA 92025, (619) 432-6446

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In the July issue, **Pat Patterson** called attention to the Donor Profile page of the April issue, which pictured class president **Alice Kimball** paddling her canoe on Hartland Pond. Alice's gift to the MacLaurin Pooled Income Fund made her a member of the '36 MIT Sustaining Fellows, as shown in **Henry Lippitt**'s November letter to all of us. And, as Alice said in the profile, "I diversified my investment, increased my income, and avoided the capital tax," benefiting both herself and the Institute. . . . When she was class secretary (for 25 years!), my habit was to read '36 Notes, and perhaps scan a class or two ahead and behind us, but pay little attention to the following pages. Speaking to a classmate recently, I found that he had this habit, and had discarded the April issue without noticing the donor page. So I sent him a photocopy, and will be happy to

oblige anyone else. Drop me a note, and add a vignette about yourself.

The tribute to Alice prompted a question to Henry: How have we been doing as a class over the years? His report is favorable: "Although we have lost some 100 members in the last ten years, the total annual giving to the Alumni Fund has increased. Even excluding the very large special gifts that some privileged classmates have made, and our 50th reunion extra effort, the typical gift has doubled, thanks to all of you"—and to Henry, **Vince Estabrook, Lou Stahl, Elliot Robinson,** and their many helpers.

Alice took a camping trip to South Carolina in March, and met up with **Towers Doggett** and Doris. Which brings to mind a clipping from the Portland paper headlined "Oh, Those Doggetts Are At It Again," and telling of their several domestic engineering feats over the years. On a trip home from Florida, they managed to pack into their camper an engine (not an outboard) for a 25-foot boat. More recently he built a catamaran in three rooms of their home (which were in the course of being made into a spacious kitchen), with a bay window that popped out to exit the finished craft. And for a vacation home at Sugarloaf Mountain, when they were still skiing, he designed a prefabricated structure in his Westbrook, Maine, yard, took it apart for trucking, and assembled it at Sugarloaf one-two-three. Neighbors at both ends were mystified at the sudden disappearance and appearance. Doris was a telephone engineer at a secret British installation during World War II, and I suspect she has been more than a little help to Towers in these endeavors.

Footnote to Phoebe's and my Portugal trip: It was through the Doggetts that I learned of the package on my visit in 1989. A neighboring couple had just returned enthusiastic, and they supplied the agency name and number. They repeated the trip this year, and we enjoyed their company and know-where-to-visit.

Gordon Thomas writes from Florida: "You recall **Jim Schipper** [indeed I do—we worked together at T.C.A.], one of us who slipped into the class of '37. Jim became a wheel with Corn Products, worked all over the world, retired as a director, and lives in Naples. His wife collapsed and passed away suddenly early in March. I attended the service, representing all of us." It must be a blow, Jim—our sincere condolences. . . . Also from Gordon: "**Mal Holcombe** was written up in the Naples paper lately as a director of the new North Naples Hospital. Mal has been associated with Naples Community Hospital as a volunteer and director for many years, giving thousands of hours of service. He lives about 30 miles from us, and spends time at Hilton Head. A real nice guy with a lovely wife." There was no answer at Mal's telephone for the two days we were touring near Naples in spring 1988, and I'm sorry we missed seeing them. Gordon—how about being our regular Florida reporter?

Continuing **Bob Gillette**'s note to Henry from last issue: "I keep busy with business and volunteer boards, and maintain a small office with a day-per-week secretary. Keeps me from going stale, and keeps me out of the house, especially at lunch! Serve on the board of the Federal Home Loan Bank of Boston, which is responsible for the thrifts in the six New England states. Although New England is by and large untouched by the savings and loan scandals and problems, we have an interesting grandstand seat to watch the procedures in Texas and southern California."

55th Reunion News. A feature of our gathering next year will be a class luncheon elsewhere in Cambridge on Thursday, June 6. The meeting will follow, and a program similar to the 50th well-received presentation will be included. To everyone far and near: please note this date for your attendance, whether you can be with us on subsequent days or not. And for your convenience in reaching old friends about their plans, an up-to-date class directory will be mailed to you by November 1, in time for your mailing of seasonal greetings. These and other arrangements were on the table when several members of the committee met with Alice at Hartland Pond on May 1. Present were **Ken Arnold** and Pauline, **Eli Grossman** and Vivienne, **Augie Mackro** and Virginia, **Pat Patterson** and Marian, and Cambridge affairs chair **George Parkhurst** and Barbara. You will be hearing by direct mail this fall when more details are confirmed, and this column will try to have timely items, notwithstanding printing lag.

Cheers for the lives of **Bob Johnson, John Sullivan,** and **Ben Woodruff!** . . . Bob died February 6 of cardiac arrest after months of decline from an energetic life, including a trip to South America via the Canal with wife Priscilla in January 1989. After graduation he practiced naval engineering with Gibbs and Cox in New York, but with the ebb in shipbuilding he went into industrial sales with International Nickel and Dodge Steel. As Priscilla puts it, "He was a born salesman, and couldn't sit still even after retiring." So he took up North Shore real estate, but continued building ships—fine models. In World War II he was an army captain in North African action. Priscilla continues at 136 Aspen Avenue, Swampscott, Mass., when not traveling, including an MIT Quarter Century trip on the Danube, which they had planned before Bob's death.

John Sullivan died January 6. Following graduation he got a law degree at Boston College Law School and served in the Chemical Corps in England, retiring with the rank of colonel. He was assistant to the director of the Boston Port Authority for a number of years, living in Arlington, and later worked for the federal government in New Jersey. John's wife Mildred died in the mid 1980s, and he came to live with his brother Thomas in Brighton until his death. Ben Woodruff died last November 3 at the age of 79. He joined the class from the University of Chicago as a graduate student in Course X-A, and corresponded through **Bill Rousseau** with a group of X-Aers in the classes of '34, '35, and '36. His career was with Du Pont at West Virginia facilities, retiring in 1977. In 1988 he wrote, "My attachment to chemical engineering is now very tenuous. I have a dream about making nylon or formaldehyde now and then, sometimes pleasant, but once in a while a nightmare." Ben and wife Susan traveled much, and visited their scattered children and grandchildren in Alaska, Texas, Detroit, etc. As Bill puts it: "They were good travelers, happy together." Both were at our 50th reunion. Ben never failed in his contributions to the Alumni Fund *and* to the X-A Practice School Fund. Bill's group of 40 is unique in providing a fully funded fellowship, to the tune of a six-figure amount per fellow. Susan continues at 925 Ridgemont Road, Charleston, WV 25314.—**Frank Phillips,** secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson,** assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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Paul W. Allen, of Pasadena, Calif., retired from Cyprus Mines Corp. as executive vice-president in March 1980 and now works as a self-employed mining consultant. His and wife Marjorie's sports are cross-country skiing, mountain climbing and hiking. Recent travels were a cruise to Spitsbergen, Norway, and Copenhagen, and a trek in Nepal. He writes, "Am going to Spitsbergen in April for a two-week skiing and camping trip. Will visit Russian metal mines in June with people-to-people group." . . . **Ross E. Black** writes from Waterford, Conn., "Have relapsed into one of my first hobbies, ship model building, and carried out a project of 51 years standing. Built not one, but two models of a trawler wrecked here in the 1938 hurricane, using wood scavenged from the original ship's wreck. One model to keep and one to sell. I keep busy on a

variety of projects—mostly nonprofit."

In the late 1960s, Mrs. Edward Winslow sought to establish scholarships in civil engineering in memory of her son, **Gilbert Winslow,** who died in the tragic Coconut Grove fire in 1942. That's when she met Hugh Darden, whose office at MIT arranged annual meetings between Mrs. Winslow and the recipients of the scholarships—civil engineering students, as Mr. Winslow had been. The next gift, in 1971, was the Winslow Career Development Professorship in Civil Engineering, and the meetings expanded to include the young faculty members involved. After Mrs. Winslow's death, the annual meetings continued with Mrs. LaVon P. Linn, Mr. Winslow's sister. In spring 1989, in appreciation for a long and pleasant relationship, Mrs. Linn established a new scholarship named for Mr. Darden. Lola M. Matysiak, a junior in civil engineering from Brooklyn, N.Y., has become the first D. Hugh Darden Scholar at MIT. Mr. Darden is associate treasurer and director of capital gifts and legal affairs at MIT, and the scholarship is a tribute to the friendship that grew between Mrs. Winslow and MIT's representative. Mrs. Linn and Ms. Matysiak met at the recent Winslow annual luncheon.

H. Arthur Zimmerman of Shaker Heights, Ohio, writes, "Agnes and I celebrated our 45th anniversary last September with a trip to Hawaii, where we'd never been. We took the one-week cruise on the Hawaiian-American line and then spent five more days on land, winding up our return home with two days in San Francisco. (Fortunately, this was before the earthquake.) A few weeks ago, **Joe Keithley** entertained the local Harvard Business School Club at his plant. This is a most interesting operation which Joe literally started from scratch. He showed us photographs of his first facility, a small one-room area which he rented for the munificent sum of $8.50 per month. This business now amounts to around $90,000,000 per year. **Ed Hobson** was in town and both of us had the privilege of sitting with Joe during the dinner. I have seen Ed Hobson several times a year for the past four or five years, as his son operates a business in this area. The local MIT group has a monthly session in one of the downtown luncheon clubs. At the last of these (January 24th) Fred Reuter, '38, told me that Marge and Dick Young, '38, were in town. They were here to see Rhea Smith (wife of Chuck Smith, '42), who was seriously ill. Marge and Dick were especially close to the Smiths when they lived in Cleveland. I am sorry to have to report that Rhea Smith passed away on January 27. Personally, Agnes and I are both well. I'm still carrying on at the Cleveland Commission on Higher Education, but as it has been decided to convert this to a full-time position, just how long that will last is indefinite. Let me close with best wishes to all members of the class."—**Lester M. Klashman,** secretary, Brookhaven at Lexington, Unit 307A, Lexington, MA 02173

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The **Al Wilsons, Ira Lohmans,** and **Dick Muthers** (joined by the Walt Helmreichs, '40) enjoyed a delightful coastal cruise in June 1989 from Bergen, Norway, to the Russian border and back. Can you imagine any trip more exciting than a 2,500-mile cruise amongst all those fjords? . . . In the 1960s, Al and Carol Wilson served as host family for an Indian student, Vinod Jhunjhunwala, who graduated from MIT with SB and SM degrees (class of 1965). In February Vinod's daughter was married in Calcutta. Among the guests at her were wedding were Al and Carol, who subsequently spent another two-and-a-half weeks sight-seeing in India.

Peer Cody has lived up to his promise to write as soon as he and Mary returned home to Illinois from baby-sitting for their daughter's children in Chantilly, Va., and a visit to Hilton Head Island. The Codys have lived in Barrington, Ill., for over 20 years—a bit surprising since Peer now is basically retired and both of them came from coastal areas. Nancy grew up in La Jolla; Peer, in New England. However they do come east annually, visiting their two sons in Newton and Plymouth, respectively. . . . Although retired from Brown and Root petrochemical activities in Chicago nine years ago, Peer continued to be involved on a consulting and limited-activity basis with several Chicago-area firms. He keeps physically active with golf and tennis (every Saturday morning at 7:00 am—yes, 7:00 am). In addition, he continues his hobby of cutting and facetting colored gem stones, natural and synthetic. Their daughter Alison graduated from Purdue; son Alan has his master's from MIT's Sloan School; and Eric took classes at the Institute in the course of getting his master's from Harvard. Maybe Peer and Nancy will have a chance to visit some of us in the Boston or New England vacation areas when they visit their sons in Plymouth and at New Hampshire's Little Squam Lake.

Dave Beaman is still living in Poughkeepsie, N.Y., where he is enjoying his retirement from IBM. Both he and Jane continue singing in their church choir. They also sing for a week each summer in the The Berkshire Choral Institute program in Sheffield, Mass. At the time of our class mini-reunion (this is being written in May), they will be in Colorado attending the graduation of their oldest son from Denver Theological Seminary. Then in August they will be in England to sing with the Berkshire Choral Institute in Canterbury Cathedral and then will do some sightseeing around England and Scotland. . . . Although I don't recall hearing from **Howard Milius,** Dave informs me that he expects that he and Jane will be attending the wedding of Howard to Ella Dohrman Pethick. Ella is a graduate of Wilson College. Congratulations, Howard!

Betty and **Abbott Byfield** claim to be loafing at their home on Sanibel Island, Fla. However, much of their time must go into their various volunteer activities. The Sanibel-Captiva Conservation Foundation (their "conservancy") accounts for a large share of their time. Ab has just completed a four-year term on its board of trustees. Betty, in turn, is in charge of the volunteers in the Nature Center gift shop. They continue to enjoy boating activities on some of the most beautiful day-cruising waters in Florida. They are members of the local Power Squadron and participate in teaching boating-safety courses as well as taking courses themselves.

Ab has just been elected a director of the Island Water Association—a private corporation formed to develop sources and treat and distribute water to island homes and businesses. IWA today now pumps some 3 million gallons per day to 10,000 customers. Brackish well water is treated in two plants—one being a state-of-the-art reverse osmosis unit. With southwest Florida running low on water, this promises to be a challenging and time-consuming assignment in the coming years. When the Byfields lived in Wisconsin, they vacationed in Sanibel; now that they live in Sanibel, they spend part of each summer in northern Wisconsin. Although he doesn't see many classmates, he does frequently see **Howard Johnson,** who has a home about a mile away.

In the July issue I promised some gleanings of highlights from **Barney Oldfield**'s professional career. Two days after graduation he took a summer job at Glenn L. Marten Aircraft, returning in the fall to MIT for graduate study and with an appointment in Stark Draper's Instrumentation Lab, first as research associate and later as Instructor in charge of its Vibration Lab. Having taken R.O.T.C. in 1941, he was called to active duty where he was assigned to the Coast Artillery's Anti-aircraft Fire Control Section. There his major project, with which he was involved through most of the war, was one of the MIT Radiation Lab's outstanding successes. Following the war he joined the Electronics Division of GE in Syracuse as manager of Air Force Sales of the Government Division. For his background, he had really fallen into a rose garden. The job of marketing was really one of systems engineering. With the first years of the Cold War and then the Korean War, there was a great increase in military requirements and a growing scarcity of engineers. Consequently his next mission was to persuade corporate and university administrations to develop a cooperative venture—the GE Advanced Electronics Center at Cornell University. Within three years, it consisted ot 200 professional and support staff.

In mid-1954, Barney pulled up stakes to develop the GE Microwave Lab at Stanford, patterned after the Cornell operation. About this time Bank of America had contacted SRI to develop a computerized system for its checking-account bookkeeping. So while director of GE's Microwave Lab, he became critically involved in this three-cornered project of BofA, SRI, and GE. They were successful in outbidding giants like NCR, IBM, and RCA. However, GE's Site Selection Group refused to locate this new operation either at MIT or Stanford, so ERMA (acronym for the BofA system) was located in Phoenix. In early 1958, the first ERMA system rolled off the line. Shortly after this, Barney's wife's doctor urged her for health reasons to forsake the desert climate.

Returning to the Boston area, Barney became assistant manager, then manager of Raytheon's Equipment Division. After more than five hectic years back in government business and shuttling to and from Europe and living there, he resigned in 1963 and joined Dick Leghorn (MIT '39) as vice-president of DASA, a company with a wide line of products in the data-communications field. Through a series of mergers they branched out into Cablevision, medical and biological sciences, and automatic health testing. By 1975, GD Searle bought out the operation Barney was most involved in, so he and some associates formed their own consulting group. When another company of which he had become president was acquired by outsiders, he decided to retire—first to the Cape and now to Kona, Hawaii, where he hopes to satisfy his yearning to write a series of novels based on the evolution of "High Tech."

Now it is my sad duty to report the passing of three of our classmates. . . . Our class past president, **Jack Bethel,** died April 10, following a long illness during which his fellow townsman, **Ed Hadley,** kept in close and helpful contact. Many will recall Jack from our undergraduate years through his activities with R.O.T.C. and the Catholic Club. From graduation until 1975, except for five years of military service, he was associated with the Boston consulting firm of Metcalf and Eddy. He completed his service tour of duty with the rank of major. In 1975, as E.V.P. of Metcalf and Eddy, he took early retirement in order to found his own consulting engineering firm in fields of civil and sanitary problems. He was past president of the New England Water Pollution Control Association. Of his extensive travels he most enjoyed a period in Australia as consultant to that government. His two principal hobbies were travel and sailing—having been an incorporator of the West Dennis Yacht Club. Our deepest sympathy to Eileen, who accompanied Jack at so many of our class events.

Charles Johnson, who attended Harvard and Carnegie Tech as well as MIT died January 24 at his home in Springfield, Mass. He was formerly on the staff of the U.S. Customs and Immigration Service. A resident of Springfield the past 30 years, he was active at his churches: Holy Name Church in Springfield and St. Christopher's Church in Peaks Island, Maine.

Jack Phillippi's widow recently wrote us from Largo, Fla., of Jack's death last November. Al Wilson had encouraged him to join us at our 50th reunion, but the Phillipps at that time were in the midst of moving to Florida from their home in Connecticut. Possibly some of his Course I or Beta Theta Pi friends can pass along information of Jack's most recent activities, professional and otherwise, for inclusion in future class notes.—

Don Severance, secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181; **Ed Hadley,** assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Class President **Seymour Sheinkopf** writes: ". . .**Fred Grant** agreed to chair our 55th reunion, and I know we will have another great one. . . . **Ernie Kaswell** and Yolande came here (Burtonsville, Md.) to help us celebrate the 40th birthday of our son Paul. . . . Sylvia and I plan a motorhome trip to Northwest USA this summer, and we look forward to seeing you and Hilda again." . . . **Jim Barton** was honored again for 21 years of service he and Mary gave their community. *The Bellevue* (Wash.) *Journal American* reports: ". . . a new 'pocket' park is to be formed along State Road 20. The park is to be named 'Barton's Park' after former longtime mayor Jim Barton. Dedication ceremonies are to be sometime this summer."

Harold Snow was featured with his picture and an article in the *Portland* (Maine) *Press Herald.* Until his retirement in 1981, Harold served as president and chairman of the board of the F.H. Snow Canning Co., famous for Snow's Clam Chowder. Both the 1945 stage musical *Carousel* and the 1956 movie version featured sea captain named Enoch Snow (no relation to classmate Harold). However, Harold's grandfather was named Enoch Snow and as that coincidence became known, Harold and his father (founder of the canning company) were asked to participate in the promotion of the movie. Harold sold the company to Borden in 1969. . . . **George Beesley** and Eleanor report the availability of a few extra 50th-reunion color photos of our assembled class. To have one mailed, send a $20 check payable to MIT Class of 1939 to George at 14 Apple Ln., Lynnfield, MA 01940.

Bill Murphy and Anne report from Clearwater, Fla., that Bill scored an 86 in golf during April. At the time, these newlyweds (married December 9, 1989) were deciding whether to spend the next month or two in New England or Oahu. . . . **Win Reed** and Margaret are in good voice and spirits as they remodel their home in St. Louis. Their son Winthrop III captained the Tufts University soccer team this year.

Mike Herasimchuk relays news of the death on May 18, 1989, in Conway, N.H., of **Benjamin J. DeSimone.** Ben's metallurgical career included consulting on the Manhattan Project, work at International Nickel and Curtis Laboratories, and operation of businesses he established to manufacture stainless-steel parts. Ben closed his manufacturing businesses in 1964 to join two daughters in establishing a restaurant in a prized location on Santa Monica Pier. A newspaper clipping dated January 18, 1989, reads: ". . .it's hard to say which is the more beloved institution, this famous Boathouse Restaurant on the Pier or its genial owner, Ben DeSimone. . . . Ben is probably one of the few restauranteurs in the world with an MIT degree in metallurgical engineering."

We are saddened to receive this letter from Mrs. F. Wallace Tobin: ". . .I am writing to inform you of the death of **F. Wallace Tobin, Jr.,** on January 26, 1990. He retired 14 years ago from his position as supervisor, Remotely-Piloted-Vehicles Project Office, at the Naval Air Development Center, Warminster, Pa., where he worked more than 35 years in the fields of aeronautical and aerospace engineering. . . . "—**Hal Seykota,** secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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Eleanor A. Norris of Norwell, Mass., writes, "President of our 1st Parish Cemetery Corp. (voted in the one time I was absent!). Not a bit dull. My job seems to be mostly diplomatic—soothing hurt feelings. Finally got enough money by various strategies to get the main portion of white picket fencing repaired and stained before another hurricane depletes our emergency fund again." The account of her visit to the Galapagos Islands was reported in an earlier column.

One of his close personal friends wrote that **Boger Wright** of San Jose, Calif., had hoped to be with us for the reunion but is confined to a nursing home, and is in no condition to travel. His wife passed away in 1988, and his only sister lives in Plymouth, Mass. He is fortunate to have a good friend to devote time to his care.

Sadly, I must report the tragic, accidental death of **I. Seth Levine** and his wife in West Redding, Conn., on February 21, 1990.

Donald M. Cole, Jr. sent a note about the death of **Charles Lindbolm.** Don and Charles were among six Course XVI graduates who went to Lockheed Aircraft after graduation. The two of them drove together across-country to Burbank, Calif. Don left Lockheed the following year for military service, but Charles remained there until his retirement.

Robert Gould of Mirror Lake, N.H., writes of the death of **Stewart E. Miller.** He says, "Stew and I were roommates in our senior year in Senior House. We were both in the Bell Labs VI-A option, so we were close to each other at school and at work at Bell Labs. He was a fine gentleman and a brilliant engineer." Enclosed in Bob's letter was an item from the *IEEE Bulletin* about Stew. It refers to him as a pioneer in optical-fiber communications. He spent his career at Bell Telephone Laboratories pursuing and managing telecommunications research. He retired in 1983 as director of the Lightwave Telecommunications Research Laboratory and continued to do consultation work for the lab until his death. The *Bulletin* goes on to say: "Much of his career was devoted to advancing lightwave technology. His research teams in optical-fiber and millimeter-wave work laid theoretical foundations, invented needed components, and proved that prototype systems were commercially feasible. He was also instrumental in transferring lightwave and millimeter-wave wave-guide systems from research to development. Following the invention of the laser in the early 1960s, Miller and his researchers began to explore optical communications, concentrating on beam waveguides that employed periodic focusing elements and associated components for ultra-high capacity transmission over long distances. Later in the decade, his team was among the first to work on optical fibers in communication. Besides directing research, Miller contributed several theories that helped to advance telecommunications, such as his coupled-wave theory, which provided a useful analytical tool for solving many electromagnetic-wave problems associated with practical microwave and lighwave devices. He also advocated using integrated optics for optical communications, which became a fertile research area. He published 50 papers and was awarded 84 patents."

We now have more information on **Alfred N. Ackerson,** who died last December 16. During World War II, he served as a meteorologist in the U.S. Army Corps. He then worked at Clark Equipment in Jackson, Mich., until 1962, when he joined New Process Gear, North Syracuse, N.Y. After his retirement in 1984, he did independent consulting at home and abroad. He was an active church member and Sunday School teacher, chairman of Outreach Work Area, and past president of the North Syracuse Board of Education. He and his wife were foster parents to more than 40 children. He worked with Threshold Jail Ministry, Priority One, and Metro Mission. Chappell's selected him as the person most representing America in 1974, and he received the North Syracuse Knights of Columbus Today's Patriot Award in 1976, both in recognition of his years of service to the community.

The Nashua, N.H., *Sunday Telegraph* recently featured **M. Arnold Wight, Jr.** In 1986, Arnie founded a consulting firm, Principled Negotiations Inc., in Amherst, N.H., to assist government, business and civic bodies in the resolution of policy disputes concerning energy, environment, and natural resource issues. The company also gives training seminars in the principles and practices of effective negotiation. After graduation, Arnie served in the U.S. Navy Reserve, worked two years for the Nashua Corp., and then spent 28 years with Rohm and Haas Co., from which he retired in 1975 as eastern regional vice-president of sales. He has served ten years in the New Hampshire Legislature, where he chaired the House Science and Technology Committee for four terms and served on committees to help establish state policy on growth management, economic development, and energy. He is working with the Energy Assurance Council and federal and state governments in efforts to develop a policy for disposal of nuclear waste. He hopes that a resolution will be reached within the next year-and-a-half to two years.

This is the last column to be written before the 50th reunion. I am sure that the momentum of that great event will spur many of you to send in your reminiscences about the meeting, as well as about your lives. This correspondence should be addressed to **Richard Gladstone,** secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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David S. McNally, McAllen, Tex., whose exploits you found in the July issue of *Technology Review,* continues his story, an update from the 25th Reunion Book.

"My responsibility was to establish the site, build the plant, equip it, and get it into operation as operation vice-president. We broke ground on October 10 and took occupancy April 10, with the first productive output on June 8, and the first complete final assemblies accepted in August. To give you some idea of scope (and the problem of dimension), the floor area was 140,000 square feet. Peak single-shift production required about 475 workers, with 150,000 meals produced not uncommon. Each morning about 90 tons of raw material had to be on line by 8 AM startup. Any flow problems created havoc with this schedule. Production became war, with every day another battle! By the time I decided to retire for good(?), we have successfully delivered some 60 million meals, all on schedule."

Dave continues to say that he enjoyed creating a complete manufacturing plant from scratch and having a free hand in production engineering. "The employees and their supervisors were all new hires, and knew only what we taught them. Although I have built quite a few assembly plants in the past (beginning with Packard's Utica Plant and Emphenol's Hollywood, Fla., plant), this was the most successful one by every measure."

Dave is very enthusiastic about McAllen, Tex., about 70,000 inhabitants; across the Rio Grande lies Reynosa (about 6 miles from their home) with a population of 400,000. It will be great for all of us to catch up with Dave at our 50th.

Speaking of the 50th reunion, **John Sexton** and I have just nailed down Chatham Bars Inn, a favorite reunion spot that you will enjoy.—**Joseph E. Dietzgen,** secretary, Box 790, Cotuit, MA 02635

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Please send news for this column to: **Ken Rosett,** secretary, 191 Albemarle Rd., White Plains, NY 10605

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The news volume has dropped back to subnormal again. There is an obituary notice for **Peter G. Von Wiesenthal,** who died February 20 in Manhattan. Peter spent his career in the field of high temperature heat technology, working with Petro-Chem Development Co., Foster Wheeler

Commencement gave the Class of 1943 an opportunity to honor classmate Virgilio Barco (left), president of Colombia and keynote speaker for the occasion, with an engraved Revere bowl in recognition of "his statesmanship and courage in the service of his country." (Right to left) Ralph Leader, Christian Matthew, Eugene Eisenberg, Kenneth Warden, Jr., and James McDonough made the presentation.

Corp., Alcorn Combustion Co., and Heat Research Corp. He served as president and chairman of Alcorn, and retired in 1976 from the presidency of Heat Research. Peter owned Snowberry Farm in Hudson, N.Y., where he raised thoroughbred race horses. He is survived by his wife Ruth, two children, and a granddaughter. We extend our condolences to his family.

Bill Thurston rides again. He has just been elected a director of Rogers Corp., Rogers, Conn. Bill is still chairman of GenRad and the Massachusetts Technology Park Corp., a member of the Massachusetts Board of Regents of Higher Education, an Incorporator of Wentworth Institute, and a member of the MIT Corporation's Visiting Committee for the Department of Electrical Engineering and Computer Science. He is also a director of the State Street Boston Corp. and of Data Instruments, Inc. Rogers Corp. manufactures electronic interconnection materials and components.

Talk about your missing meat and potatoes! Space constraints and editorial exigencies for the May/June issue of the *Review* left half of my Albq Report on the cutting-room floor. Any classmates wanting to read the unexpurgated version may send a stamped self-addressed envelope to receive a copy.

No further word at this point from **Stan Proctor** and the 50th Reunion Gift posse. But never fear, you will hear. . . . —**Bob Rorschach,** secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Stan Warshaw was in Moscow for a few months. He reports that consumer goods are in very short supply, and the quality and quantity of local foodstuffs leave something to be desired. If all goes according to plan, he will be back in Russia by the time you read these notes. . . . **"Doc" Turner** writes that he has completed his "winding-down" period and is now fully retired from the University of Maine. His definition of full retirement includes volunteer work, gardening, house maintenance, some consulting, teaching an occasional seminar, and supervising a master's thesis. He and Dot went to Alaska for two weeks last year and plan to go this August to Germany, Austria and Switzerland. "Doc" and Dot also manage to visit their four children and three grandchildren, although not as frequently as they would like. . . . In July 1989, **Henry Bowes** finished his career as vice-president and program manager of science and engineering for Lockheed at NASA Johnson Space Center. He and Betty are traveling the country in their motor home.—Co-secretaries: **Andrew Corry,** P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles,** 77 Circuit Dr., Hyannis, MA 02601

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Please send news for this column to: **Clinton H. Springer,** secretary, P.O. Box 288, New Castle, NH 03854

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Back from our East Coast odyssey (odd-asea?) after a 4,700-mile round-trip in Bettie's Shadow, we're both playing catchup. We visited a few dozen old friends and families, even more than we had hoped to see. Two of them were **Al Little** and his wife, Marian, at their very pleasant home in Media, Pa. The visit was truncated by a bumper bender on the way that held us up a while, but Al and Marian made up for it by treating us to lunch at the Brandywine River Art Museum. After a nice chatty lunch, we toured a gallery full of the Wyeth family's paintings amongst other things. Al is working full time at G.E.'s Princeton plant (entailing a 140-mile round-trip commute), teaching management at LaSalle and Widener, white water kayaking, and announcing Scottish Highland games. Lord knows how he does it, but he looks and carries it very well.

While in Hilton Head (see the July column), I tooted across Port Royal Sound to Beaufort to visit **Roger Bart** and his wife, Elaine, at their winter quarters overlooking the Inland Waterway where their comfortable-looking motor-sailer was tied up a pitch shot away from their condo. They seemed in good spirits, with all of their children grown up and gainfully employed. I caught them a couple of weeks before they shoved off on their sail back up to their Martha's Vineyard summer home. I think they said they take about a month, including a stopover or two, to visit friends along the way. Looks like the good life to me! . . . Toodle-oo. Catch ya later.—**Jim Ray,** secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Sorry, not time to write a column this month because we are in the process of making the move to Colorado that we announced in last month's column. We'll catch up on the news next month!

Editor's note: Anneke Dubash, 475 Elgin St., Apt. 1512, Ottawa, Ontario, Canada, K2P 2E6, sends this request—"I am in the process of writing a biography of my father, **Soli Dubash,** and would like to have any information that might be available on his university days. He attended MIT between 1940 and 1942, left to join the Canadian Army, and returned in 1945 graduating in 1947 with an SB in mechanical engineering. He passed away on March 24, 1987, after a distinguished career in the engineering field. I recall him saying that he was an avid skier and sailor, so he may have been active in clubs with these interests. Any stories or anecdotes from friends who remember him would be appreciated."—**Robert E. McBride,** secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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Vic Pomper started a home satellite TV company in 1981. In 1983 he took the company public and in 1984 acquired subsidiaries in the Ft. Lauderdale, Seattle and Ontario areas. They were riding the wave of the booming satellite TV industry, but unfortunately the wave curled over them—in 1987 the satellite industry virtually collapsed, despite the fact that the benefits remain strong in outlying and rural areas. Vic lives in beautiful rural N.H., where he dives off his dock, swims, canoes down the channel, or rows out in the lake despite the power boats roaring past him. He is working on a book on entrepreneurial and innovative management which a major publisher long ago asked him to write. He is alert to other opportunities since the fun of building a business cannot be erased from his psyche. He quotes Edgar Cayce: "We have a work to do. If we make of it a burden, we are slaves. If we make of it work, we are men. If we make of it play, we are gods." Vic sees himself as a grown-up kid building grown-up sand castles in a grown-up sand box. He and his wife, Anne, get along as well as they did over thirty years ago, and the kids turned out well.

After graduation, **Milt Slade** earned his ROTC commission at Camp Wood in New Jersey. Then he joined the Research Laboratory of Electronics at MIT and worked on missile telemetry and hydrofoil control systems while doing graduate study. He also worked for RCA and Sanders Associates in a variety of military electronic systems. Since 1976 he has been at GTE Government Systems and has program management responsibility for automatic test systems, ground support equipment, and tactical communications. Milton and his wife Jean have lived in the same house in

PHOTO: PAULA M. LERNER

Concord since they were married in 1951. Their four daughters are on their own. Jean went back to work after the children left home, and after ten years of work she has retired. Milton has been an active officer of our class. He has served on reunion committees and was treasurer from 1938-88. He is now our class agent and is active in the telethons to increase alumni gifts to MIT. He has also been active at his church, and he was an officer and served as chairman of several professional groups related to his work.

Stan Shein worked in various production and distribution management positions with Macy Department Stores, Texaco Oil Co., and an apparel manufacturer from graduation until 1963. Then he joined a CPA firm and managed their consulting services. Since 1968 he has had his own firm and has pioneered in providing solutions for inventory intensive companies on each new generation of computers. He currently offers a multi-user business software product that is hardware- and programmer-independent. His daughters did not follow his advice: one daughter married an MIT graduate, and the other daughter married a lawyer.

Bob Welch went to work for Ludlow Corp. after graduation and remained there for 33 years, including ten years in senior management. Tyco Laboratories acquired Ludlow in an unfriendly takeover in 1981, and most of the senior management, including Bob, left the company. Bob and a partner purchased from Tyco one of the Ludlow operations, which makes specialty threads and twines for the electric, electronic, industrial, shoe and furniture industries. Bob is chairman of his company. Bob and his wife Margaret live in Wellesley. Their three children are well-launched. Carolyn is a physician; Bob Jr., '80, works in the electronics industry; Nancy is a computer program consultant with a major company. Bob's and Margaret's major interests center on family and church. Hobbies include sailing on Long Island Sound (where they keep a sloop near their summer home) and cross-country skiing. Bob is a director of several small companies, trustee in the local hospital, and president and director of a local civic organization.

Melvin Berkowitz died after a lengthy illness. He was the retired owner of New England X-Ray and Electronics, Inc., of Littleton, Mass. He had lived in Newton for many years. His wife Sylvia, four children, and nine grandchildren survive him. On behalf of our classmates, I extend our sympathy to Sylvia and the rest of Mel's family.—**Marty Billett,** secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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In October 1989 *Forbes* reported that **Charlie Jordan**'s son, Mark, was making a name for himself in the automotive world as a designer of "the hottest car in America right now. "To Charlie, however, hot cars are nothing new because he has been designing them for years. The January 17 issue of the Big Rapids, Mich., *Pioneer* reported that Charlie gave a lecture at Ferris State University on "Design—Where in the World Are We Going?" He said that future consumers will look not only for quality, value, and fuel efficiency in cars but also for "emotional" factors such as how the car sounds and how the driver feels when he sees it, sits in it, and drives it.

In a ceremony at the Boston Museum of Science on February 8, **George Hatsopoulos** received the museum's Inventor of the Year award. Coming up with an invention, George says, takes "a lot of work and a lot of luck—and passion. You need to want it very badly." George's company, Thermo Electron Corp., of Waltham, Mass., was started in his garage in 1956, and is now among the nation's largest corporations. Inventions have been its stock in trade, including a portable drug detector, radon and bomb detectors, machines that clean gasoline and other chemical contaminants from soil, and a heart-assist device for cardiac patients. To be successful as an inventor, George says, requires a sense of what's needed. It's easier to find a problem and invent a solution for it than to invent something and then find a problem it solves.

Frank Brunetta is founder and president of NYGENE Corp., in Yonkers, N.Y. The company's latest product is the AutoMASS 1000, a completely automated membrane affinity separation system that drastically reduces the time and cost required to purify monoclonal antibodies and other biopharmaceuticals used to detect, diagnose, and treat cancer, AIDS, and other diseases. MASS stands for Membrane Affinity Separation System and, prior to its introduction, a senior scientist could spend an entire day using standard technologies to purify just 10 grams of pure monoclonal antibody. Now, using the AutoMASS 1000, one junior technician can process and purify 250 grams of monoclonal antibodies a day—an efficiency improvement of 2500 percent over standard technologies.

Bill Schneider writes, "After ten years at Computer Sciences Corp. in Calverton, Md., I retired at the end of March 1990. I don't plan to quit working altogether, however, since CSC has asked me to remain on as a half-time consultant and I am already a consultant on five NASA Advisory Committees. (That keeps me up-to-date on the space world.) I will also consult for a few other aerospace companies. But, in the end, I hope I'll be able to do more things which interest me. This makes my second retirement. I left NASA in 1980 after many fun years, when the space program was young and carefree!"

Dora Harford writes from Atlanta, Ga., "After 39 years of a wonderful marriage to Stoney, it is with deep sorrow that I report the following: **Jabez Stoness Harford** died during open heart surgery at Emory Hospital, March 22, 1990. He was 65. Stoney was employed with Niagara Blower Co. for 37 years, serving in sales engineering capacities in New York and Atlanta. He is survived by his wife and two daughters." The class extends its condolences to Dora and her children.—**Fletcher Eaton,** secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Donald Ramsey recently retired from Rochester Products Division of GM after 39 years of service. He was senior product engineer responsible for patent contact, legal liaison procedure development and compliance. He was recently elected to a two-year term as supervisor, Town of Chili, a suburb of Rochester, N.Y. . . . **Al Dell'Isola** this year was elected to senior vice-president of Smith, Hinchman & Gryllis Associates, Inc., of Detroit. He is located in the Washington, D.C., office and is director of the Value Management Division. He lives in Fort Washington, Md. . . . **Richard Rorschach,** who lives in Kilgore, Tex., is still in the practice of law, but only slightly. He spends most of his time managing two small oil and gas minerals companies. He recently started on the T-factor diet, and combining that with a brisk 30-minute walk every day has resulted in a 15-pound weight loss.

Sterling Brisbin, who lives in Nokomis, Fla., for at least half the year, continues to provide expert testimony and management review of consulting engineering firms. He still enjoys tennis, golf, and woodworking in his leisure time. . . . **Dan Flanders** has been working in shipbuilding for the past 19 years at the Ingalls yards in Mississippi; though he intends to retire in a few years, he is planning to stay on the Gulf Coast. Dan's wife died seven years ago, but he is now engaged to a lovely Southern widow. . . . **Ken Olsen** has been inducted into the National Inventors Hall of Fame. . . . **John Litchfield** is employed as a research leader at the Battelle Memorial Institute in Columbus, Ohio, where he has worked for the past 30 years.

Joe D'Annunzio recently returned from the Soviet Union as a member of the Public Works Technical Group of the American Public Works Association. The visit was requested by the Soviets as a gesture of friendly cooperation. Joe is president of D'Annunzio Associates, Inc., a hazardous waste and heavy construction firm located in New Jersey.

John Malloy, who recently retired from Amoco, has been writing a book that shows investors how to manage their money like modern corporations. *Successful Investment Strategies—Using Security Analysis to Build Wealth* should be in print by the time you read this column. Good luck to John and his readers.

We are sorry to announce the recent deaths of three fellow classmates. . . . **William Johnston** of Short Hills, N.J.; **Charles D. Nolan** of Wayzata, Minn.; and **Richard Timothy Daly** of Castine, Maine.—**John T. McKenna,** secretary, P.O. Box 376, Cummaquid, MA 02637

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Following retirement after 37 years in the communications business with ITT, **Paul Smith** is enjoying an attempt to convert a 108-acre farm from a weekend toy into a self sufficient break-even or profitable farm operation. . . . Anticipating his retirement next year, **Donald Brown** has recently purchased land in Cape Rosier, Maine, and in North Captiva Island, Fla.

We received the sad news of the passing of **Harold Rich** in October 1989. Together with his family, **Roy Weinstein** prepared and sent us this obituary. . . . Hal passed away on October 15, 1989, after a long illness. He graduated from Kemper Military Academy in 1947, after which he entered MIT and majored in food technology. He was a member of the Pi Lambda Phi fraternity. His studies were put on hold while he served in the U.S. Army from 1952 until his honorable discharge in 1954. While he remained in the Army reserves until 1957, he also resumed his studies at MIT in food technology and received a PhD in 1957. At MIT, he was also a marketing major and completed all course work for the MBA. During his graduate school residence, he was the first recipient of the General Foods Fellowship, which he held from 1954 to 1957, and was elected to the MIT chapter of Sigma Xi in 1956. Hal always retained contact with MIT and served on the Visiting Committee in Food Technology from 1970-1976.

After receiving a PhD, he served for two years as a senior staff member at Arthur D. Little Co. in Cambridge and in Chicago. In 1959 and 1960, he assisted with his family business in Chicago and developed advertising and promotional equipment for Design Tech, which was acquired in 1963 by White Way.

During the next eight years Hal served as vice-president of corporate planning and research development at Sara Lee, Consolidate Food Corp., in Deerfield, Ill. He initiated and established a manufacturing facility for the Institutional Division of Sara Lee. He was instrumental in pioneering the in-flight service program for the airline industry. While at Sara Lee, he developed and marketed over 50 new products, more than half of which are still being sold. During his tenure with Sara Lee, sales grew from $25 million to $76 million.

For the following seven years, until 1976, Hal worked for Consolidated Food Corp., E. Kahn and Sons, in Cincinnati. He was first the executive vice-president and then CEO of this multiplant meat company that manufactured a wide range of processed, smoked, fresh, and frozen products. Here again Hal Rich left his usual mark, as company sales rose from $80 million to $175 million.

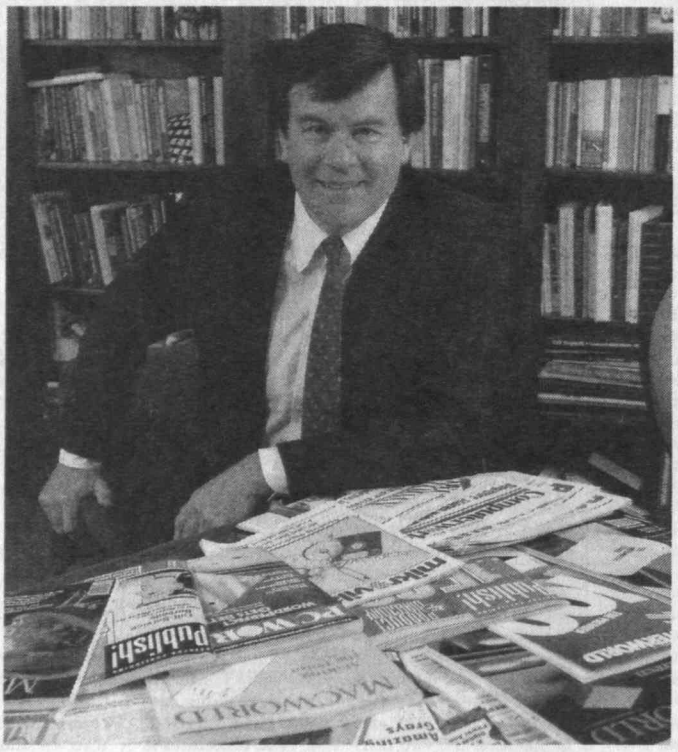
He worked for Stouffers Foods from 1975 to 1979 in Ohio as a member of top management where he was accountable for all phases of the

BY KIMBERLY FRENCH

Patrick J. McGovern, '59: Chronicler of the Information Age

Known as a cheerleader at his own company, International Data Group (IDG) in Framingham, Mass., Pat McGovern knows how to work a crowd. At the Enterprise Forum conference on "The Entrepreneur and the Global Economy" held at MIT last fall, McGovern jumped up to the mike while some of the 300 participants were still munching on their luncheon steaks and ripped off his first joke in the best toastmaster style.

"When you start to expand your business overseas, you can almost expect the unexpected to happen," he related. "I made my first trip to Japan 20 years ago to give a talk on the vision of the information society as a successor to the industrial society. I was the first speaker, and I talked about how the migration of information technology around the world would give us better education and social services by the 21st century. I went on for about 15 to 20 minutes on this, and there was a light ripple of applause. The next speaker got up and talked for about a minute, when he was interrupted by a nice round of applause. He went on another minute, and another round of applause. The next time I started to join in. By about the fifth time I was virtually leading the applause from the stage, when the gentleman next to me tapped me on the shoulder and said, 'Uh, Mr. McGovern, could you restrain yourself? That gentleman is translating your talk.' "



Patrick MGovern peruses a few of the 125 magazines his International Data Group publishes in 40 countries.

In fact, all of his numerous anecdotes poked fun at himself—his faux pas in telling jokes to foreigners, his penchant for setting up magazines in tropical climates, his struggles as an undercapitalized startup (riding the bus for 99 days on $99 and collecting checks he couldn't cash because he hadn't established a corporate name)—and served as an effective way to put his listeners at ease. Especially coming from someone who everyone knows has a lot to brag about.

The skill of getting people excited about his message is one McGovern has fully exploited in building IDG. Begun with $10,000 from each of 12 companies interested in a survey on computer use in 1964, IDG is today a $500 million international empire with 125 magazines in 40 countries. McGovern's management style is legendary—*Inc.* magazine last year picked him as the CEO of its "dream team"—and so is his rise from a Philadelphia paperboy with big ideas to the leading chronicler of the information age.

At age 51, he notes that he is celebrating his 43rd year in the information-providing business. While he was delivering newspapers, two events occurred that began to shape his life. When he was only nine years old, he read a book by Edmund Berkeley called *Giant Brains, Or Machines That Think.* Its ideas inspired him to write an essay for a national contest on what he wanted to do when he grew up: make computer power available around the world. He won $500, which—compared with his 50-cent hourly wage—made him "a firm advocate that the mind is more powerful than muscle," he says.

Second, in high school he used $20 of his paper-route money to build a relay-based computer system—with carpet tacks, bell wire, plywood, and flashlight bulbs—that played an unbeatable game of tic-tac-toe. Local MIT alumni took note and provided him with a full scholarship. Among his many returns on that investment is the $1.5 million he pledged to establish the Patrick McGovern Professorship of Management Information Systems in the Sloan School of Management.

While studying biophysics at MIT, McGovern served as editor of *The Tech.* He went on to become associate editor of *Computers and Automation,* the first computer magazine in the country, which was founded and edited by the same Berkeley who had written *Giant Brains.* McGovern quickly adopted Berkeley as a mentor.

McGovern's vision was his guiding force from the beginning. In 1959, he predicted that computer use would increase by 30 percent per year. At the time, only 50,000 people around the world had access to computers. "Everyone thought I was absolutely crazy," he remembers.

In 1964 he attended a press conference for a new RCA product called random-access card equipment memory, but couldn't get anyone to explain its application. "I said, we must be wasting a lot of . . . money to make technology products when we don't seem to have a vision of how they're going to be helpful to people," he recalls.

Soon after, he hit upon his first market-research project—calling every U.S. company that might have one of the 6,000 computers then in use to find

out how the machines were used. That endeavor was the beginning of IDG's market-research arm, called International Data Corp., now the largest firm of its type in the world.

The companies interested in seeing the results of that first survey paid him entirely up-front, which is how McGovern has funded all his ventures. He has never raised money from investors or taken a bank loan. When he started the weekly newspaper *Computerworld* in 1967, he invested his entire net worth, about $50,000, to develop a prototype. He displayed the prototype at a trade show, where he sold 30,000 prepaid subscriptions that provided him with the working capital to go into production. Today *Computerworld* grosses $60 million and is the largest specialized business publication in the country.

In 1972, he moved into the global arena, starting a magazine in Japan, then in Britain, Germany, France, and Brazil. "Information is not something that's really exportable in its current form," he says. "People want to get information highly shaped to their needs, in their own country, written in their style, in the local language, in a format that looks attractive to them. We're essentially running a restaurant business. We provide a recipe for how to gather, edit, process, and deliver information. The local manager goes to the market and obtains the ingredients, then cooks and seasons to local tastes."

Each of the 72 IDG corporate units has its own president and business plan. McGovern explains his management style this way: "You find the very best people you can, agree on a plan with them, then get out of their way. Each corporate unit is like a node on an electronic communications network. We at headquarters are like a file server to facilitate the competitive effectiveness of each company. To make sure that we only support and don't interfere, we keep 18 people at headquarters serving 3,600 employees around the world."

To keep all those employees—more than half of whom are overseas—productive and excited about their jobs, McGovern uses several techniques. One is an extensive evaluation and bonus process, in which customers are surveyed about the best products and services and all employees are surveyed about the best managers. Another is a worldwide employee stock ownership plan, which already represents 25 percent of the company shares. McGovern has promised that when IDG reaches $1 billion in sales, now ambitiously projected for 1992, he will turn majority ownership over to employees.

What excites McGovern most these days is expansion into previously closed Communist countries. In 1980 he set up *China Computerworld*, the first joint venture in information technology with China. He proudly reports that the launch of the publication was accomplished in 30 days, and it had 20,000 prepaid subscribers in the first week. His joint publishing venture in Hungary, set up in 1985, is the fastest growing branch of IDG, he says, going from one staff member to 175 and from one publication to 13 in three years. "All of a sudden you have these tremendously well-educated people with a lot of energy and for the first time experiencing freedom. They are dying to have a chance to create something," he says.

And in April 1989, McGovern set up the first joint-venture publication agreement with the Soviet Union. "It's a completely supply-limited economy," he says. "If you can get a product into the market, it's quickly swept up. We published 100,000 copies of *PC World USSR*, and five hours later they were all gone. The next day they were resold on the black market for 10 times the cover price."

To would-be entrepreneurs, he offers this advice: "Why should you be thinking globally? If you want to count in your market, consider that by the year 2000 your market is going to be outside the United States. Twenty-five years ago, 76 percent of the computer marketplace was in the U.S.; by 1970, 70 percent; now, 42 percent; by 2000, 22 percent." If you're not a player in the global market, McGovern warns, the only other option will be to have complete control of some market niche. □

The author is a free-lance writer and editor based in Cambridge. She has written for Omni, Yankee, *and the* Boston Globe, *among other publications.*

business including profitability.

Since 1979, Hal had resided in Houston and worked to develop a restaurant concept called Main Street U.S.A. He was engaged in this activity when ill health forced him to retire.

Hal was a professional member of the Institute of Food Technologists since 1951 and was a member of the American Chemical Society, American Association of Cereal Chemists, Society of American Bacteriologists, the Illinois Academy of Sciences, and a fellow of AAAS. He held over a dozen patents and published many articles on food facility operations, corporate development, and corporate management. He is survived by his wife, Cornelia (Sunny), and his daughter, Cornelia (Cori) Tyner.

We extend the condolences of our class to Hal's wife and family.—**Martin N. Greenfield,** secretary, 25 Darrell Dr., Randolph, MA 02368

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To tell the truth, I find the thought of retirement a little depressing, so it was good to hear from **Howie Zasloff** that he has *un*retired, returning to his former employer, Lummus Crest, as director of licensing

Andy Wessel has not so much retired as changed vocation, taking over the family farm after selling his marine business two years ago. He says, "My wife and I love being farmers full time. If anyone would like to see how we dry our annual grain crop with sun energy, we would sure appreciate a visit." Andy's farm is in Sandvika, Norway, about ten miles west of Oslo.

Bob Damon is not retired at all and, furthermore, says he is still participating in triathlons. Last year Olin transferred him from East Alton, Ill., to a subsidiary, Rocket Research, in Redmond, Wash., where he is director of marketing for solid propellant products. He says his wife, Bobbie, wonders why it took them 34 years to discover the Puget Sound area. Bob and Bobbie's daughter in Alabama recently presented them with their first granddaughter, after three grandsons. Their other three children, who live in Texas, are married, but with no children yet.

One of our class capitalists, **Donald Christensen,** is now at Potomac Venture Associates, of Bethesda, Md. He is still a director of Greater Washington Investors, of which he was formerly president.

Until I received word that he died last February 10 at age 74, I had not realized **John J. McCarthy** was a classmate. I remember him as the RLE staff member one went to for help with microwave problems. He had joined the old Radiation Lab at what must have been its inception in 1940 and had stayed at its successor, RLE, until his retirement in 1980. A resident of Gloucester, he is survived by his wife, three sons, and seven grandchildren.—**Richard F. Lacey,** secretary, 2340 Cowper St., Palo Alto, CA 94301

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Please send news for this column to: **Gil Gardner,** secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Bill Eccles retired as chairman and professor of electrical engineering at the University of South Carolina, to become "an itinerant visiting professor, hopefully for the next several years." Bill's son is at Rose-Hulman, and his daughter just graduated from high school. . . . **Howard Brody** hopes that you saw his segment of "The NFL Today" last December 3, when he explained the physics of football. Later in December, he gave a lecture to the Inter-collegiate Tennis Coaches Association on the physics of tennis. . . . **Marilyn Leader Shilkoff** is a gerontologist, working for

the Westchester County (New York) Office for the Aging. In June, she presented a paper in Beijing at the first Sino-American Conference on Women's Issues, on the topic, "Sex Segregation in the Workforce: How it Impacts on Older Women." Marilyn publishes *The Women's Letter,* a newsletter for older women in Westchester, and is active in many groups trying to help older people, especially women, deal with their special problems. Her son is a physician, and her daughter is a college philosophy major. . . . **Paul Spreiregen** designed the State of Maryland Vietnam Veterans Memorial, which was dedicated in May of last year. It is in Baltimore and deserves your attention if you are in the area. Paul also conducted a national design competition recently for a National Peace Garden. The winning design, among 930 entries, was by M.I.T. Professor Emeritus Eduardo Catalano. . . . **Don Goldberg** sends word that GZA, a company he founded with **Bill Zoino** to do geotechnical and environmental consulting, had a successful initial stock offering last summer.

I am sorry to report the deaths of several classmates. **Don White** and **John Goncz** died last December and **Carl Bohne** died in January. Don was an engineer with Digital Equipment Corp. in Maynard, Mass.; John was a geophysicist with Teledyne Geotechnical Corp. in Alexandria, Va.; Carl was an engineer with Honeywell's electro-optic division in Lexington, Mass. Our sincere sympathy goes to Edith White, Patrice Goncz, Madeline Bohne, and their children.—**Edwin G. Eigel, Jr.,** secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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This is definitely the calm before the storm—only one item to report this month. **Allan Schell** informs us that he has been serving as chief scientist of the Air Force Systems Command since 1987. He states that he has adapted to the Washington weather and finds the other climates there very interesting.

The next edition will give you the report of our 35th reunion, so be prepared.—**Robert P. Greene,** Apt. 11-2A, 100 Memorial Dr., Cambridge, MA 02142; **DuWayne J. Peterson, Jr.,** 201 E. 79th St., Apt. 11-I, New York, NY 10021

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The 35th class reunion is scheduled to be held on campus September 27-29, 1991, to provide the current flavor of the Institute, with students, and to be the most outstanding (one and only?) alumni/ae class on campus. A block of rooms and a hospitality suite has been reserved at the Sonesta on the environmentally upgraded Charles River . . Chairs **Lloyd Beckett** and **Ted Korelitz** were involved in a reunion kickoff meeting with class president **Ron Massa,** and sponsored by the Alumni Association to provide ideas and define support. A class meeting was held in May to set up committees to discuss and initiate the planning process. Another class meeting will be held in September to continue planning and work input. The tentative theme of the reunion is ethics, an appropriate topic for these or any times. The Museum of Science is being considered for a banquet site. Make advanced plans to come, and contact Lloyd (6 Radcliffe Circle, Bedford, MA 01730, 617-275-5234) or Ted (136 Beethoven Ave., Waban, MA 02168, 617-969-8540), if you would like to offer suggestions or participate in the planning meetings.

Margolia C. Gilson has just retired from Lincoln Laboratory after 10 years and is expanding her custom-jewelry business under the name Margo's. She and Lloyd ('55) became grandparents for the first time last October.

Dr. **Elhanan E. Ronat** died of natural causes October 14, 1989; he was just 57. He is survived by his wife Judith of 9 Alcalay St., Rehovot 76304, Israel. God Bless. . . . In case you did not hear it elsewhere, Professor **Harold E. "Doc" Edgerton** died of natural causes at the age of 86. As the "father" of strobe photography, Doc's impact on MIT and on society at large was great.—Co-secretaries: **George H. Brattin,** 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin Gross,** Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Please send news for this column to: **John Christian,** secretary, 23 Fredana Rd., Waban, MA 02168

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This month, we are indebted to Larry Peterson, '36, for providing some news for our column. Larry sends additional information about **Roy Thorpe,** whose passing we reported in the April 1990 issue. The information comes from *Private Varnish,* the official magazine of the American Association of Private Railroad Car Owners, an organization which Roy served as president, Amtrak liaison officer, at-large director and editorial advisor during its first 12 years. As a founder and charter member of AAPRCO, Roy was always in the forefront of private car innovations and ideas, including development of the country's first private car park in over 55 years, at Pompano, Fla., in 1985. Roy attended the 10th Anniversary Private Car Convention in Pittsburgh aboard his open platform private car, "Intrepid."

While on a business trip to the West Coast recently, I visited **Toni Schuman.** She is with TRW Systems Engineering and Development Division as a deputy program manager. Her son, Eric, graduates from UC/Santa Barbara this year and works in the environmental field.—**Mike Brose,** secretary, 841 Magdeline Dr., Madison, WI 53704

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Please send news for this column to: **Allan S. Bufferd,** secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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I'm writing this to meet a May deadline, so there is yet no news from our 30th reunion. Nevertheless, I'll bring you up to date with the correspondence I've received recently.

Robert Hodges writes from Phoenix that he and his wife, Karen, had dinner with Alice and **David Geisler** when the Geislers were visiting Phoenix.

Linda Sprague is still at University of New Hampshire. In addition, Linda serves with England's Manufacturing Management Center at Cranfield, as well as being management advisor to the Societe Internationale de Chirurgie Orthopedique et de Traumatologie (SICOT).

From Cincinnati, **Amadeo Pesce** writes that he was part of the faculty union team during negotiations with the administration of the University of Cincinnati. Amadeo says that they used faculty from the MIT-Harvard Negotiations Project to train them in mutual gains bargaining. (I hope that both sides found it to be a win-win situation!)

A note from **David Perry** says that he has resigned from the Middletown (N.Y.) Psychiatric Center after eight years as a staff psychiatrist. David is now in a solo practice of general psychiatry with emphasis on psychodynamic, psychoanalytically-oriented individuals and group psychotherapy.

Susan Schur continues to add to her design and advertising laurels. The MIT Club of Boston recently selected Sue's design for a new logo—a stylized version of the Great Dome with the "MIT lettering representing both the columns of the building and the forward thrust of the Club's activities." Congratulations again, Sue!

Sadly, I report the deaths of two classmates. . . . **Robert V. Storer** of Bedford, Mass., died in November 1988 of cardiac arrest. Robert is survived by his wife, Judy. . . . **Richard F. Smith** died January 25, 1990, in Dallas, Tex. Dick was a partner in the law firm of Gardere and Wynne and had served on the Dallas City Council from 1975 to 1980. Dick is remembered in Dallas as a man committed to public service, particularly to the mass transit problems of the community.—**Frank A. Tapparo,** secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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Our reunion is officially scheduled for June 7-9, 1991, according to **Bill Hecht,** executive vice-president of the Alumni Association. Bill wants ideas on the type of reunion people want. And the hidden agenda is to have us cough up more money for the class scholarship fund, which has helped a dozen students so far. With tuition going through the roof, this is how we can help people like us to get through the 'Tute.

Joe Harrington has entered politics: He was elected town meeting moderator in Westborough, Mass., last March. It's a huge job and takes a great deal of tact, charm and humor. Town meetings last 3½ days in Westborough; the other 361½ days of the year, Joe works for New England Power Co. as vice-president. His wife Diethild teaches at Worcester State College; son Joe, '88, does graduate work at MIT in astronomy; son Roberts majors in biomedical engineering at Syracuse. The Harringtons also work on bits and pieces of the Appalachian trail, with the hope of cleaning up the New Hampshire section this summer.

John Benjamin writes, "Since leaving INCO in 1984 after 19 years, I have been a bit of a metallurgical gypsy. I spent two years with Cabot Stellite, one year with Stoody Delro Stellite (after an external LBO) and one year with GAF (who announced an internal LBO one month after I arrived). I am now at the ALCOA Technical Center as director of advanced alloys and processing, with responsibility for a group of about 200. It is challenging and enjoyable. As the ALCOA liaison person for MIT, I get the chance to visit the campus every few months."

A few honors for classmates this month: **Don Hartill** became a fellow of the American Physical Society "for significant contributions to the experimental understanding of deep inelastic *e-p* scattering and e^{+-}*e physics in the J/psi and psi(4S) regions and in instrumentation and accelerator physics.*" . . . **John Sununu** received the Washington Award, sponsored by the Western Society of Engineers, for "professional attainments that have advanced the welfare of mankind." . . . **Steve Klenman** received an honorary doctoral degree from the University of Copenhagen (presented by the Queen of Denmark) for work with algebraic geometry and enumerative geometry and his work in the theory of intersection. I wasn't aware of the Danish Queen's interest in abstract geometry.—**Andrew Braun,** secretary, 464 Heath St., Chestnut Hill, MA 02167

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Charles G. Heinrich has been named president and chief executive officer of Sherritt Gordon, Ltd., of Edmonton, Alberta, Canada. Charles was formerly president of Alcan Pacific, Ltd., an operating unit of Alcan Aluminum of Montreal. Sherritt Gordon is a major metal mining, refining and fabricating company, which also has important investments in the chemical industry. . . . Although his legal residence is in Palm Beach, Fla., **William Koch** was listed in the April 1990 issue of *Boston Magazine* as the third richest person in the Boston

area, because he maintains a modest 179-acre Cape Cod hideaway. Bill is recognized as one of the world's top 200 art collectors by *Art News* and serves as a trustee of the Museum of Fine Arts in Boston. You may recall that one of our 25th reunion events was held in the newly refurbished William I. Koch Tapestry Room at the museum.

Joseph S. Perkell has been promoted from principal research scientist to senior research scientist in the Speech Communication Group of The Research Laboratory of Electronics at MIT. Since his affiliation with the Laboratory in 1964, Dr. Perkell has conducted research in speech physiology and articulation, and recently completed an advanced system to track the movements of speech articulators. Joe is also a lecturer in oral diagnosis and radiology at the Harvard School of Dental Medicine. . . . **Erich P. Ippen** has been named a fellow of the Americn Physical Society "for his pioneering work in the generation, measurement, and application to physical systems of picosecond and femtosecond light pulses." . . . **John A. Rollwagon,** chairman and chief executive officer of Cray Research, Inc., gave the commencement address at the winter graduation exercises of Clemson University last December. John received the President's Award during Clemson's sixth and final centennial graduation ceremony. John has been a member of Cray's board of directors since 1980 and was named chairman in 1981. Cray is the leading supplier of supercomputers and is headquartered in Minneapolis, Minn.—**Hank McCarl,** secretary, P.O. Box 352, Birmingham, AL 35201-0352

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You read this column because we have some things in common. These things we have in common imply other interesting things. You are an MIT graduate, probably in the class of 1963. You also care enough about the Institute to contribute money, which is why you get *Tech Review.* Finally, you are concerned enough about your classmates to take time to see what is going on with them.

Unfortunately, I have no news to share with you this time. The past few months have been sparse, in fact barren. That is why I have decided to spend this entire column, although a short one, asking for your help.

As a responsible MIT graduate, please care enough to tell your classmates about their classmates to be looking here for news. Over the past years, they have also contributed news. It may be a long time since you bestowed news on your classmates, so now would be a good time. You will feel better for it, and it's really painless.

Talk about anything you have been doing or feeling. It could be a professional accomplishment, perhaps short of the Nobel prize but something that gave you great satisfaction. Maybe it was seeing your own child graduate college, or a first visit with a first grandchild. You may want to write about traveling you promised yourself for years and finally did. You may even have some pain you need to share. In short, please tell us about anything you would want to tell if you were sitting in one of our living rooms.

To make it easier, you do not have to write. Just pick up the phone and call me (day, evening, or weekend) at (301) 750-0184, and I will take notes. In any event, we'd all like to hear from you!—**Phil Marcus,** secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043

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It's a rather diverse set of items to report this issue. . . . From **Patricia Page Wilcox** comes a note that she is doing automated typography for the Amiga computer and working on a master's degree in computer and information science at Ohio State. In her spare time, she hopes to have planted a garden. . . . Carnegie Mellon University named **Bob Mehrabian** its new president effective July 1. He will be leaving University of California, Santa Barbara, where he was dean of the College of Engineering. Bob received an SB and ScD in Course III and then joined the faculty at the Institute. Later, he served as director of the Center for Material Science at the National Bureau of Standards. As academic budgets grow tighter and tighter, the challenge of leading a university becomes more difficult. Best of luck, Bob!

Charles Heinrich has been appointed president and CEO of Sherritt Gordon Limited and has been elected to the board of directors. Sherritt is a diversified Canadian public company engaged in the marketing of fertilizers and chemicals, the refining and sale of metals, and the development and marketing of specialty metal products. Previously, Charles had been president of Alcan Pacific Limited in Vancouver, B.C.

Index Technology Corp. announced a management restructuring under which **Fred Luconi** will serve as president and COO. All operating managers will report directly to Fred, who will be responsible for day-to-day company operations. Index Technology is located in Cambridge and since its founding in 1983 has been a leading provider of computer-aided software engineering products. Fred continues as chairman of Applied Expert Systems, Inc., also located in Cambridge.

As the preceding two paragraphs suggest, I'm really good at "appropriating" phrases from press releases. If one is issued about you, please make sure that the Institute receives a copy. In any event, please drop a line when you get a chance. Thanks.—**Joe Kasper,** secretary, RR 2, Box 4, Norwich, VT 05055

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A short column, but maybe this will reach you just at summer vacation time. And by now, I should be secretary no longer (but I don't know who the replacement will be). . . . **Richard Nathan** sent a note that since January 1989 he's been group vice-president and general manager of Batelle's Nuclear Systems Group based in Columbus, Ohio. Batelle is an independent technology company that puts technology to work for government and industry worldwide. Richard's group provides technical and management services to its clients, primarily federal and state government. Richard also says that daughter Wendy is a sophomore at Washington University in St. Louis, and son Daniel is a high-school sophomore.

The Alumni Association sent along an article from *Sail Magazine* about **Steve Loutrel**'s boat, the *Adelie.* Steve designed the boat for cruising along the coast of Newfoundland, Labrador, and Baffin Island, where the Loutrel family sail and then go ashore on remote coasts for hiking and exploration. Among *Adelie*'s unique features are built-in landing gear that allow the Loutrels to bring the boat ashore without the need for motorized assistance. The article also mentions that Steve is director of engineering for Navtec of Littleton, Mass., a manufacturer of hydraulic systems and rod rigging for yachts. Steve, Elizabeth, and their children Laura and Daniel have been cruising north in *Adelie* since the boat was completed in 1987.

A brief column for summer reading. Enjoy.—**Steve Lipner,** secretary, 6 Midland Rd., Wellesley, MA 02181

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Please send news for this column to: **Jeff Kenton,** secretary, 7 Hill Top Rd., Weston, MA 02193

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Jeff Shapiro has been appointed associated department head of Electrical Engineering and Computer Science at MIT. After receiving his doctorate from MIT in 1970, Jeff was appointed an assistant professor at Case Western University. He returned to MIT in 1973 and was promoted to professor in 1985. As a principal investigator in the Communications Group at MIT's Research Laboratory of Electronics, Jeff performs research that is focused on signal analysis and communications theory in optical propagation, communications, and imaging. . . . **Bob Domnitz** was the sole contender in the race for a planning board seat in Lexington, Mass.

G. Peter Beardsley is an associate of pharmacology in the Graduate School of Arts and Sciences and associate professor of pediatrics in the School of Medicine at Yale University. He is also chief of the section of pediatric hematology and oncology at the Yale School of Medicine and director of the pediatric oncology program at the Yale Comprehensive Cancer Center. After receiving an MD from Duke in 1974, he held postdoctoral appointments at Yale and Harvard Medical School. He then served as instructor in pediatrics and assistant professor of pediatrics at Harvard before joining Yale in 1985.

Theodore Postol of MIT has been named recipient of the 1990 Leo Szilard Award by the American Physical Society. . . . **Philip Rosenkranz,** a research associate since 1973 in the Radio Astronomy Group at MIT's Research Laboratory of Electronics, has been promoted to principal research scientist. His research includes remote sensing of the earth using microwaves, microwave propagation in the atmosphere, and planetary radio astronomy. . . . **Stephen Marcus** is a partner in the law firm of Frandzel & Share in Los Angeles, where he specializes in business and commercial litigation. He and his wife, Carol, have three children—Josh, 19, Rebecca, 17, and Daniel, 16. Steve reports with deep regret the death of **Alex Pitegoff** on October 18, 1989. Alex died of heart failure while in Los Angeles. He had been working as an engineer for Polaroid in Cambridge, and was active in the community affairs of Brookline, including service as a tenant advocate and member of the Brookline Rent Stabilization Board. He is survived by his wife, Linda Gold Pitegoff, his son Daniel, and his daughter Emily.—**Jim Swanson,** secretary, 878 Hoffman Terr., Los Altos, CA 94024

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Please Please send news for this column to: **Gail** and **Mike Marcus,** secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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I dread receiving this kind of message from the MIT alumni/ae office, but a note attached to a Deceased Alumni Form reports the death of classmate **Samuel Jacobs** of Newport News, Va. The note from a family member reads, "Samuel died of cancer on October 7, 1989, at age 42. His tragic death came as a shock to many friends who loved him. He is survived by his mother, and brother Abe."

More pleasant news comes in a note from **Farrel A. Powsner:** "In the interest of learning what other classmates are up to, here's a brief bio: I am married to Sheila Beckoff and have three children: Steven (14), Lori (12), and Michael (7). Upon graduation I started teaching high-school mathematics at John Dewey High School in Brooklyn and am still there as assistant principal, mathematics supervision." . . . **Thomas R. Moebus** has been named director of the MIT Industrial Liaison Program, capping his ILP affiliation since 1981. In 1985 he became assistant director and in 1986 associate director.

An interesting note arrived from **Randall J. Hekman** of Rockford, Mich. who may lead us all in at least one respect: "I have been a Probate-Juvenile Court judge for the past 15 years in the

BY DAVID P. HAMILTON, '89

A Scientist Applies Himself to Education

Volunteering for community service is one way to learn about the world outside one's usual experience and, ideally, a way to change lives—however slightly. But for Michael Efron, '65, doing volunteer work while still an MIT student gave him a chance to learn important things about himself and changed his own life irrevocably.

Like many of his fellow physics majors, Efron entered MIT intending to work one day as a research scientist. Scientific careers, and physics in particular, enjoyed wide public approval in the years bracketed by the launch of *Sputnik* and the escalation of the Vietnam War, and Efron's predilection for science and technology made that choice a natural one for him.

Two years later, however, he was vaguely dissatisfied. Physics absorbed an enormous amount of time that Efron felt he would rather spend elsewhere. "I was really more inclined to do something with people," he said. Inspired by Lyndon Johnson's Great Society rhetoric, he turned to community service. Efron described the choice as an "ideological decision," a way for him to help resolve the disparity between the wealthy MIT community and the poorer neighborhoods of Cambridge.

In his junior year, he helped found the Social Service Committee (SSC), a student-run organization that sent volunteers to staff a Boston City Hospital emergency room and a school for the handicapped. Later that year, Efron and other SSC members helped launch a community-based tutoring program that would eventually become Tutoring Plus. (*See February/March, page MIT 8-17.*)

"Throughout my junior and senior years I struggled with whether to stay in physics or to do some kind of community service," he said. He started his senior thesis research in the Cambridge Electron Accelerator under Professor Martin Deutch and won a full-tuition graduate scholarship from the Atomic Energy Commission. But his public service work kept encroaching on his study time, until he was spending nearly 30 hours every week on each.

The difference between his two worlds was "remarkable," Efron said. "It really bothered me."

An epiphany of sorts during his senior year helped him resolve the conflict. As a volunteer with a Cambridge settlement house, Efron spent time helping to write a $15,000 grant proposal. That modest sum would fund an additional staff member for a year. "At the same time, I was working in [a physics] lab where our annual damage bill alone had to be $30,000 to $40,000," he said. "I once dropped and broke an $800 photomultiplier tube and expected to catch hell for it. Instead, they told me, 'Don't worry about it.' They sent me back to this cabinet, and when I opened it, it was full of these tubes." The difference between his two worlds was "remarkable," Efron said. "It really bothered me."

Moreover, Efron decided that a career in physics required more dedication than he could muster. The prevailing attitude in the laboratory seemed to be, "If you're in physics, you dedicate your life to it," Efron said. It became clear that he'd have to give up spending time on people and their problems, with no assurance that he would ever accomplish anything significant as a scientist.

Switching to the study of education, specifically educational psychology, was for him the transition to working with people. In addition to his theoretical interest in how people learn, Efron was impressed with the potential of education to lift poor children out of the underclass. He earned a master's degree in education and a doctorate in psychology from Harvard and went on to a series of jobs in high-school guidance counseling. His career path included several years at an experimental Boston high school that recruited 100 underachieving students while they were freshmen and sophomores and attempted to "get them on the college track," he said.

In the early 1980s, Efron accepted a job as principal of the Cape Elizabeth High School in Maine (enrollment 550), where he stayed for seven years. Since then, he has moved up to become the curriculum director of the Cape Elizabeth district, where his major goal is to restructure the district's math curriculum.

"Math is poorly taught nearly everywhere," Efron said. Most of the problem lies with the math texts, which are "sets of skills to master, learned in isolation from practical applications. Kids learn the algorithms—adding, subtracting, and multiplying—but they never learn to apply them." Formulating the problem in this fashion makes the solution obvious, Efron added. It's necessary to orient the curriculum toward meaningful problems, giving students the problems first and then the skills with which to solve them. □

PHOTO: PORTLAND PRESS HERALD

Grand Rapids area. I have just resigned my elected position to become executive director of a newly formed organization called the Michigan Family Forum, a pro-family research and education organization in our state. As additional evidence of my wife Marcia's and my own pro-family positions, we are the proud parents of 10 children aged 18 to 1. I am working on my second book dealing with being a successful parent (which is an issue I need a lot of help on personally)."

As for my own strange doings, I just returned from (believe it or not) the First Annual Conference on Cold Fusion (March 28-31) in Salt Lake City. MIT was well represented by both "believers" and "non-believers." The newest thermal and nuclear evidence presented seems quite compelling to me—one might even call it conclusive, if (big if!) the data could be linked quantitatively to some of the theoretical mechanisms that have been proposed. But right now it isn't even certain what the "fuel" is (deuterium or trace quantities of ordinary hydrogen). One thing's for sure, it ain't classical fusion! Tough experiments ahead. I have a standing bet with world-class skeptic Douglas Morrison of CERN that by December 31, 1992, the phenomenon will be proved conclusively to be a new kind of nuclear process capable of generating excess heat. You cold-fusion buffs wanting more details, contact me at the MIT News Office or at my home. Stay tuned also for some expanded writing that I may do on the subject.—**Eugene F. Mallove,** secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Lee Fox, after 16 years at A.D. Little specializing in municipal and hazardous waste incineration, joined Clean Harbors to manage the siting and environmental impact report efforts for a new rotary kiln incinerator for hazardous waste disposal. In January, he was promoted to vice-president of the Hazardous Waste Management Group of Clean Harbors, and is responsible for operations of five treatment facilities in Massachusetts, Illinois, Ohio, and Maryland. . . . **Mark B. Ketchen** has been named a fellow of the American Physical Society, and, in recognition of his contributions to the Division of Condensed Matter Physics, received a citation "for applications of VLSI fabrication techniques to problems of condensed matter physics."—**Robert Vegeler,** secretary, Beers, Mallers, Backs, Salin & Larmore, 1100 Ft. Wayne Natl. Bank Bldg., Ft. Wayne, IN 46802

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Paul S. Snover is the vice-president of Wirth Systems, Inc. His hobby is sailing in the Boston Harbor in a 23-foot sloop. He is the father of three children: Matthew (12), Peter (10), and Emma (6).—**R. Hal Moorman,** secretary, Box 1808, Brenham, TX 77833

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Please send news for this column to: **Wendy Elaine Erb,** co-secretary, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963, **Dick Fletcher,** co-secretary, 135 West St., Braintree, MA 02184

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Crystal Sloan has made the move to God's country. She moved, last September, "sound studio and all" to a cabin deep in the woods of eastern Tennessee, telecommuting to the company she's been with for over 11 years, Cardiodata Systems of Boston, as director of Medical Information Systems. Continuing her musical activities from the woods, she edits music articles for magazines and newspapers, co-produced a CD, and manages a Zimbabwean musician, with whom she performed in New Orleans this May. Both his name and his instrument were, unfortunately, handwritten and not completely decipherable, so rather than do injustice to either, I'll concentrate the credit on the accomplishments of our classmate. One of those, of course, is her being the only source of information this month. Don't be a 99.9 percenter—write!—**Robert M.O. Sutton, Sr.,** secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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It was dark and late; I was tired and grumpy. Then I remembered that Class Notes were due. So I dragged myself home, where I spied an envelope from the MIT Alumni Association. Inside the envelope was a letter from **Danny Watt,** who says "I like your columns!" Already the day was brighter. . . . Also enclosed was a long letter from **Craig Presson,** writing in response to his birthday card. My day was made! Craig and Kathy and children Diana and Robert moved to Huntsville, Ala. ("The Rocket City"), around the start of the year. Kathy's spending the summer at poolside "at least for a while" he says, while he is senior technical manager of a systems software group at Integraph. Craig's mom couldn't be happier about the proximity to the grandchildren and the fact that Craig has finally come home from college.

Probably the most frequent contributor to this column, **Paul Schindler,** fills us in on his doings. Just after November last year, Paul's position at *PC Week* was "downsized," and he himself was "downsized right back to my old job" at *InformationWEEK* where he writes a weekly column about minicomputers and mainframes. Paul writes from home, so there was no moving required, but he was at the office in Foster City, Calif., just in time for the Big Quake. **Charalabos Psimarnos** is director of technical operations and engineering at Premier Cruise Lines, owners and operators of three passenger vessels based in Cape Canaveral, Fla. . . . **Alex Seltzer** writes, "I was recently promoted to vice-president of system integration at NetExpress, a manufacturer of digital fax switching equipment. My wife Yuka runs a Japanese translation service (specializing in finance and computers) from our home in Northern Virginia. Miki (5) is still unemployed but was recently featured in a photo essay in the local paper. Area poker players are encouraged to call."

Patricia Tellis-Warren reports the passing of **Carol Dees** in February. I have no other information at present.

At the MIT Research Laboratory of Electronics, **Jae S. Lim** has been promoted to professor in the Department of Electrical Engineering and Computer Science. Professor Lim has received a slew of awards in his eleven years on the faculty, including being co-recipient of the 1984 Harold Edgerton Faculty Achievement award. . . . Kevin Struhl, professor at Harvard Medical School, was awarded the Eli Lilly and Co. Research Award for his "prominent and fundamental" research in microbiology and immunology. The major focus of Professor Struhl's work is understanding the regulation of eukaryotic genes in molecular terms.

As of June 1, your faithful scribe is a *part-time* vice-president of product development at Target Marketing Associates in Peabody, Mass. I'm leaving to devote the bulk of my time to writing a music software idea I've been unable to make progress on in my "spare" time. Let's see what the prospect of no money coming in and a dwindling savings account does for the creative juices.—**Lionel Goulet,** secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

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Harlan R. Davis writes, "On December 1, 1989, I was hired by Midway Airlines as a DC-9 first officer. This realizes a long-standing dream of becoming an airline pilot. The five-week training period was more intensive than anything I ever experienced at MIT (perhaps because of the stakes). It is a unique and interesting profession." . . . According to the December 21, 1989, *New York Times,* **Alan B. Lefkof** is now president of Grid Systems Corp. (a subsidiary of Tandy Corp.) in Fremont, Calif.

From the December 14, 1989, *Billerica Minute Man:* **Mitchell G. Tyson** has become executive vice-president of Precision Robots, Inc., of Billerica, Mass. . . . **Scott Fulton** has joined PerSeptive Biosystems of Cambridge, Mass., as vice-president of marketing and systems development. He is responsible for analyzing market opportunities, planning and executing marketing programs, and formulating product strategy. A press release reports that "Fulton's 12 years at Amicon, combined with his industry-wide reputation for technical credibility, made him a perfect match for the company's commitment to the bio-separations market."

Robert Gerstmyer and wife Deb are still in Durham. Their daughter Anna is "lots of fun—most of the time." . . . **Allen C. Hart** writes, "In August, I began a two-year executive-on-loan assignment from my home company, Grumman Data Systems, as the technical director of Software Valley, a high technology economic development initiative in West Virginia started by Senator Robert Byrd." . . . **Phil Webber** has been appointed director of personnel programs for IBM Europe. Phil, his wife Vicki (Simmons '75) and their two children, Benjamin (8) and Elizabeth (4) will live in Paris for the next three years.

This letter from **David Sieverding** reads like "old home week": "A little over a year ago, Ray (Anderson) '77, and I moved to 'wine country' 45 minutes north of San Francisco up Interstate 101. We try to enjoy the recreational resources of the area and last year went camping on seven occasions to great locations like Yosemite, Big Sur, Mendocino and the Anderson Valley. No computers, no phones. In August 1988 we sold the Friendly Plastic Co. Fortunately, sales are doing great, and we and the other investors get a percentage for years to come. We made a big investment in computer graphics under the name Elegant Graphic Slide Service and would not mind some business from classmates. As we determine exactly where the market demand is, we offer more and more services. We do 'fancy' slides with chemical formulas, mathematical formulas, flow diagrams, and assembly diagrams; and we do simple slides too, and our prices are good. Our fax number is (707) 795-3286. Over Thanksgiving we went to Los Angeles and visited with **Susie Fuhrman**'s brother and sister-in-law, Jed, '77 and Dorothy and their infant son; with **A.J. Wilmer,** Debbie Judelson and their two adorable daughters; and with **David Dinhoffer** and his new wife Kathy, who were visiting. Kathy had managed a really big restaurant in New Orleans, and they met through David's medical school friends. They have bought a house in Brooklyn; Dave is a radiologist in business with dad, and **Peter Dinhoffer** is their business manager. A.J. is doing some consulting and is the primary caretaker for the girls; they showed us the gorgeous new house they are planning to move into as soon as it is completed (Beverly Hills splendor with a pool!)."

Susie Fuhrman is expecting her first in June. She and Larry are still happy in Minneapolis and have done a lot of remodeling on their big old house."—**Jennifer Gordon,** secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036; or 18 Montgomery Pl., Brooklyn, NY 11215

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Daniel Christman says, "After working intermittently over the last two years on remodeling the kitchen, I now have a deadline. The college stu-

dent who had been helping me with the work wants to have his wedding rehearsal dinner here in May. His parents and fiance insist that the work be finished. I am as yet undecided on vacation plans. I have a choice of three mission trips: visiting churches in the USSR, street evangelism in Amsterdam (a challenge with language), or volunteer construction in Hawaii, as I had done two years ago." . . . **From Gail Rubin Walker:** "My husband, Ed, and I just had our second child, a son, Daniel Saul, on April 9. Big sister Rebecca turned 2 in February, and she thinks Danny is fun. I'm on maternity leave from my job as vice-president for development at Hancock Software, Inc. Hancock Software is a small firm producing system software for Digital VAX, computers. I joined the firm in August of 1988 after 12 years at BBN.

Michael and **Susan** (nee **Schoenberger) Chonoles** had a son, Zev Alexander, on December 14, 1989. He weighed 9 pounds, 9 ounces. Michael writes: "Things are going well for me. . My wife, Susan, is fine and is working part-time from home managing the Publications Department for a small software company, Rabbit Software. I'm manager of Software Standards and Practices for GE on the STGT (Second TDRSS Ground Terminal) project for NASA, trying to determine the correct style, methodologies, and design practices for this very large, real time, project. Part of the challenge is fairly stiff availability requirements, never down for more than 10 seconds at a time, and under 10 minutes per year. It's hard work, but fun. . . . Currently started being interested in my family tree and have so far identified over 1,300 (*secretary's note:* not a typo!) relatives to my son. Besides a tremendous phone bill, I'm slowly teaching myself Yiddish, Russian, and Polish to translate all the old documents. It's exciting detective work. Maybe with the great changes in the Eastern Bloc, the U.S. will let me visit the 'old country' some day."

Associate Professor **David K. Gifford** at the 'Tute has been appointed to the Karl Van Tassel Career Development Chair. Dave heads a research group at the Laboratory for Computer Science where he developed the polychannel architecture for large scale distributed systems. This was tested in literally hundreds of homes and businesses in Boston. Dave's most recent accomplishment is the development of the FX family of programming languages. He has been on the faculty at the 'Tute since 1982, and also has tenure. Congrats on the appointment!. . . . **Sue Prytherch** has moved from Chicago to St. Louis, joining the law firm of Gallop, Johnson & Neuman as its executive director. She has 100 non-legal staff reporting to her. Prior to joining the firm, she was a management consultant for nine years at Touche Ross, now Deloitte Touche. . . . **Fred Tsuchiya** wound up with a profile of himself in the *Minneapolis Star Tribune,* complete with photo. He develops testing systems at MTS Systems Corp. as the project manager for the Advanced Technology Development Division. This division makes computer-based systems and software to analyze performance characteristics of materials, products, and structures, and for automating production processes. The reason for the article is that Fred was named the Minnesota Young Engineer of the Year for 1990. He was picked from a field of 10 candidates. In addition to his work as an engineer, he is an adjunct professor in U. of Minnesota's Mechanical Engineering Department. He is also a member of the MIT Educational Council. Congrats!

As for your secretary, the futures markets continue to make big moves; currencies, cocoa, sugar, interest rates, all continue to exhibit a great deal of volatility. Business is slow, however, as too many clients are paralyzed by fear, a natural side effect in some participants when volatility levels jump to uncomfortable levels. I still retain an intact stomach, having survived the extremely volatile period of 1978-81. This is not to say that I still won't blanche occasionally. For example, on the day I am typing up these notes, cocoa increased eight percent on an absolute basis. Add a lot of leverage, and you can easily imagine some of the thrills and chills I get.

With respect to the voice recognition business (Voice Recognition Technologies, Inc.), I have an important lesson to impart: making custom chips is a very expensive hobby. By the time you read this, we should be shipping in quantity our large vocabulary, quasi-speaker independent, quasi-continuous voice recognizer, a.k.a. the Scribe. This is going to be either the best investment I have ever made (and I must confess to having made quite a few already) or the very worst. There will not be any middle ground. We are aiming via our patent filings and this expression of speech recognition technology to carve out the ground level of the field, just as Xerox and Polaroid did in each of theirs. The approach used is different, with enough differences to make it possible to provide voice recognition at rates competitive with a good human typist. Am I nervous over the financial risk I am taking? Very. We did not take in any venture capital, as of the writing of these notes. We are entirely self-funded. I have not diversified my risk, unlike when I speculate in futures. So I remain your highly nervous secretary. To calm me down a bit, please write.—**Arthur J. Carp,** secretary, Voice Recognition Technologies, Inc., 220 Henly Rd., Woodmere, NY 11598, (516) 295-3632, Fax: (516) 295-3230

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This was a good month for news! Let's get right to it. **Charles Libicki,** now a research scientist at Ohio State, was one of a team of civil engineers that was awarded the American Society of Civil Engineers' Karl Emil Hilgard Hydraulic Prize. The team was awarded the prize last August for its paper on the problems of measuring the effects of dredged material, scour and toxic substances in central Long Island Sound. Charles has also created a short film, "Lake Erie Storm Surges," which described storm surges and modeling efforts. He lives in Bexley, Ohio. . . . **Beth Ganister** is proud to announce that Ganister Fields Architects has been in business five years and is doing great! She and her husband, Will, also recently celebrated the birth of twins in January, a boy and a girl. Since they also have a 3-year-old, they now have bedlam at home. . . . **Steven Gaskin** still has a way to go to catch up with my brood of three, but he is trying. His son, Michael Alexander, was born last February 9. Steve says, "He used to look like Churchill, but now he looks like Gorbachev. He already has two girlfriends."

More babies. . . . **Richard Baer's** second daughter was born last September. He is still managing Picosecond Measurements Group at Hewlett-Packard in California. . . . **William Morris'** second son, Evan, was born June 29, 1989, and joins 3-year-old Andrew. William has been promoted to head of the Design Department at Vlastimil Koubek, Architects, in Washington, D.C. He and his family live in Chevy Chase.

More career advancements. . . . **Jerry Landau** is still in the same location (Warren, Pa.) after 10 years but has recently received another promotion, this time to manager, Technical Services. In an attempt to prove his insanity, Jerry has committed himself to do a 50-mile trail run in September. He will let us know the results later. . . . Still at work at Advanced Micro Devices in Sunnyvale, Calif., is **Steven Grossman.** In the past year, his job responsibilities have grown to encompass worldwide marketing for non-volatile and static memories. He writes, "Our fastest growing market is in Japan, believe it or not. We're doing our bit to help the U.S. trade balance and maintain technology leadership here in the United States." . . . **Nina Cahan** has been in her own practice for over a year now in a suburb of Dallas. She reports that her practice is growing, and she has a nurse practitioner working for her. She is doing family practice, including obstetrics, but fighting the establishment to do obstetrics. She finds Dallas an interesting place to be a liberal Democrat. "It's unusual enough that once you meet one person, (s)he introduces you to their friends, etc., and pretty soon, you're part of the liberal underground."

Paul Ackman sends another long letter on location from Europe. Among his exciting adventures were snorkeling in the Red Sea, skiing in central Turkey, hiking nine hours through the deepest gorge in Europe (which is in Greece) then being greeted by a group of inhospitable native villagers, and falling in love with a Turkish woman, only to have her sold by her parents to an old man one day after they learned of the romance. They even refused Paul's offer to match his rival's offer! He will be spending the rest of the year touring Europe and plans to return to the United States in December. . . . **Carol C. Martin,** our class agent, and her husband, Tom, are doing well. She reports: "Our class endowed the Class of 1977 Student Financial Aid Fund for our 10th reunion gift. This fund has earned $101,180 to date (May 3, 1990). The Student Financial Aid Office this year has awarded scholarships to two students from our class fund, Bonnie Kao, '91, and James Schwonek, '90. Bonnie is from Walnut Creek, Calif. and is studying materials science and engineering. Last year, she worked on a UROP project in the Ceramics Processing Lab and assisted in research on superconductivity. James, who is from Garfield Heights, Ohio, is majoring in physics and plans to attend graduate school and teach in the field of experimental physics. For the past two years, he has been actively involved in UROP work in the Research Lab of Electronics, assisting in the construction of an atomic beam apparatus. These students have asked me to extend their gratitude to our classmates who have contributed to the Class of '77 Student Financial Aid Fund. The Financial Aid Office is also extremely grateful for the generosity that our class has shown to the Institute and to undergraduates. I'm proud that our efforts to build these scholarship funds have been so successful and that we are now making awards to needy students."

Everything is well here. Brielle is talking, Kellen is reading, and Joia is one-handed cartwheeling. Paul is in Huntsville, Ala., attending a conference on something scientific, and I am trying to get more sleep. Keep your wonderful letters coming in. We all love to hear about your lives.—**Ninamarie Maragioglio,** secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522

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We hear from two classmates this month (time to send in your news!) . . . Dr. **Debra Kaden** has just started working at the Health Effects Institute, a "very exciting place." Debra says her spare time is kept pretty busy with her two kids, Paul (almost 5) and Leila (2). Debra and family live in Arlington, Mass. . . . **Doub Ely** writes, "After a seven-year courtship, I was married in August 1988 to Judi Zazula of Medford, Mass. I am still consulting to Arthur D. Little, Inc.'s Molecular Beam Epitaxy research group. I am also still consulting to Helping Hands, Inc., which trains monkeys to aid quadriplegics. Judi is the program director at Helping Hands. In our spare time, we are working on pet projects and renovating our Victorian two-family house." Doug and Judi are living in Chelsea, Mass.

Meanwhile, your class secretary, and wife **Diane Curtis** took time out for a Marriage Encoun ter weekend. It's a great opportunity to get away from the routine and to really focus on your partner and your relationship with each other. We highly recommend this communication workshop—it's fantastic!

Please send your notes and news today!—**Jim Bidigare,** secretary, 2470 Billingsley Rd., Columbus, OH 43235, (617) 889-1817; **Julie Kozaczka Stahlhut,** assistant secretary for Networks, Inter-

net; jstahlhu@hstbme.mit.edu; Compuserve; Julie K. Stahlhut 76566,1012

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Brian Wibecan left DuPont in July 1989 and moved to Littleton, Mass., to work as a software engineer for Digital Equipment Corp. He writes, "I work in the Systems Analysis and Availability Group in VMS Engineering. It's a great place and I'm really happy I made the change. Outside of work, I'm having a great time watching my daughter grow and learn to talk. She'll be making puns in time!". . . . **Jim Walker** is still acting, recently playing the part of the Old Shepherd in *The Winter's Tale* at the Brattle Theatre. Also in the cast, playing his son, was Andrew Borthwick-Leslie '87. They ran into another MIT Shakespeare Ensemble alumnus, Daria Martel, performing in *The Father* at the American Repertory Theatre in Cambridge. . . . **David Mika** graduated from the Medical College of Virginia in 1983 and completed his residency in psychology at the Medical College of Georgia in 1987. He has been in a private psychiatric practice since 1987, presently in Charlottesville, Va. David and wife Katherine Dalton, whom he married in 1980, have two children: Matthew, 3, and Alison, 2.

The class of '79 reputation for creating twins continues: Donna and **Allen Tracht** welcomed Michael Edward and Diane Sarah into the family on May 19, 1989. Donna writes, "Both babies are tall, like their father. Given Diane's penchant for trying to disassemble things, she may be the next engineer!" The Trachts make their home in Cleveland Heights, Ohio. . . . The cover article in the March 1 issue of *Nature* magazine describes work done by **Glen Langston,** in collaboration with scientists at MIT and the Naval Research Laboratory. The article is entitled "Galaxy Mass Deduced from the Structure of the Einstein Ring MG1654+1246." Glen also has a PhD from the 'Tute. . . . Also appearing in the print media is **Gilbert Godbold,** who was the focus of an article in the *Houston Chronicle.* Gilbert runs his own company, GSG Builders, and was named "Remodeler of the Year" last December by the Greater Houston Builders Association.

As for your faithful secretary, I have only five more days of servitude to the muse of the theater. In other words, my latest theatrical venture, *No, No, Nanette,* closes in five days. We have already done seven performances, with three more to come. Actually, despite my longing for freedom after four months of unrelenting artistic toil, I have been having a wonderful time performing the show, and have received rave reviews from friends and relatives alike (even from strangers—which *must* be sincere!). My next venture: looking for a new job, since Mobil moves to Virginia in July and I have declined the offer to relocate. So if any of you know of any openings in New York City in the personal computer field, please drop me a line. Until next time—**Sharon Lowenheim,** secretary, 98-30 67th Ave., Apt. 6E, Forest Hills, NY 11374

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The class mail box was very full this month. Thanks to everyone who wrote! On to the news. . . . **Robert Bernstein** is still living in Santa Barbara, Calif., where he works for Digital Instruments doing hardware design in scanning tunneling microscopes. He is still working with groups for progressive social change and human rights. . . . **Paul Vianna** writes that he is a vice-president in Fixed Income Research at Citicorp North American Investment Bank. . . . **Craig Finseth** sent me a note from St. Paul, where he works for the University of Minnesota and is starting up its computer networking services group. He and his wife Ann were expecting their first child in May. . . . Also, new parents are **Artie Chin** and his wife Bea, who had their second child, Michael, last December 2.

Dana Gilbert is still working for the Illinois Masonic Medical Center in Chicago. He is a manager in the Marketing and New Business Development Department. He and his wife Joanie are keeping busy with their son Tommy, born in September 1989. . . . **Charlie Yie** writes that he and Margo are expecting their second child in late December. Charlie has been working for five years for Ampersand Ventures, a venture capital firm he joined after graduating from Sloan in 1985. He is enjoying his work tremendously, although the industry is in a bit of a slump. . . . Rose and **Seth Alford** had their first child, Melissa Sarah, November 27, 1989.

Barbara Johnston got married last year and was expecting their first child in March of this year. Barb still works for a real-estate development company in northern Virginia. . . . Other marriage news: **Carey Rappaport** married Ann Morgenthaler, G, in November and moved to the suburbs (Newton, Mass.). He is enjoying raking leaves, shoveling snow, and unclogging drains. . . . **Ralph Vinciguerra** married Lori Antis, G, on September 2, 1989. They spent their honeymoon out west, hiking the Grand Canyon, seeing Vegas, and cruising the California coast. They purchased their first home in Reading, Mass., and have been busily renovating and entertaining ever since.

Mary Stock and Ken Flanders, '84, were married in November 1988. They met as freshmen in Student House in 1976. . . . **Gwen (Freeman) Shafer** married Rick Shafer, '75, on June 25, 1989, in Wheaton, Md. Many MITers joined in the wedding party including: Bob Gerstmeyer, '75 (best man); Alanna Connors, '78 (maid of honor); Joe Jones, '75; Paul Veatch, '79; and Larry Loomis, '81. Gwen is currently a postdoctoral fellow in the immunology branch of the National Cancer Institute in Bethesda. Gwen pointed out the following tidbit: The 2nd edition of the *American Heritage Dictionary* uses a picture of the Great Sail (with East Campus in the background) to illustrate the word "abstractionism." Check it out!

Michael Abrams writes with lots of news: He married Robyn Melnick on September 24, 1989. **John Stenard,** Amy Stenard, '81, and **Mark Gressett** were in attendance. Mike received an MBA from Wharton in May 1989 and took a job as manager of Special Projects for Vickers—Systems Monitoring Division, in Glenolden, Pa. He is in charge of investigating new technologies and new business opportunities. He and Robyn just bought a house in Cherry Hill, N.J.

Chien Huang wrote that he finally submitted his thesis and received a PhD from Princeton. He's still in New York working for Grumman Corp., but transferred recently to the research department as senior senior scientist (sic). . . . **Tony Parham** received a master's degree in management from the Sloan School in June. . . . **Ronald Lenk** is a senior R&D engineer with Ford Aerospace. . . . **Ed Chang** wrote me a letter with the news that he joined GATX Capital Corporation (San Francisco) as a director. He was looking forward to working in Tokyo for two to three months. They will be trying to create some innovative structures for financing aircraft and railroad equipment. In his spare time, Ed enjoys hiking with the Sierra Singles.

After 18 years in the Hub (that's Boston, for those of you who may have forgotten), **Josh Herz** and family have moved back to his hometown of Rochester, N.Y.—to his family, snow, and sane drivers. They're still getting used to all three. . . . UCLA sent me a press release about our own **Tom Drake,** who received a Cray Research Gigflop Performance Award at the Supercomputing '89 conference for a model he created. His "computer model of flowing granular materials allows him to peer into the interior of rockfall avalanches and other granular flows that are usually inaccessible to observation" (to quote the article). Tome received a PhD in geology from UCLA in 1988.

Mark Cywenski moved to Oregon last year and is still loving it. He works in marketing for Tektronix's fast-growing workstation and printer division. . . . **James Franklin** continues to work as a research meteorologist for the NOAA/Hurricane Research Division in Miami. He says the 1989 season was very busy. He flew mission into Dean, Gabrielle, Jerry, and Hurricane Hugo (3 times!). Some of the rides were pretty rough. The purpose of the flights is to help improve the prediction of hurricane motion. . . . **Arthur Aaron** writes that he still works at the law firm Skadden, Arps, Slate, Meagher & Flom. His wife Patti is pursuing a career in art. Their twin daughters, Chelsea and Amelia, were 2½ years old on Christmas day. . . . **Robert Lechter** has joined the Aspen Group, Inc., a syndicator of commercial real estate in south Florida. He invites non-U.S. alumni to inquire about investing with them!

That's about it for this month. (Actually, I received two other notes from the Alumni Association; however, one had an illegible signature and one was missing a name altogether. So if your news is missing, I encourage you to write again!)

Thanks to everyone who wrote. . . . not only this month but anytime in the last five years!—**Kate Mulroney,** secretary, 118 Riverview Ave., Washington Crossing, PA 18977

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Please send news for this column to: **Lynn Lubell,** secretary, 2380 NW 41st St., Boca Raton, FL 33431

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Please send news for this column to: **Stephanie Pollack,** secretary, 135 Sutherland Rd., Brighton, MA 02146

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We received a letter this month from **Layton Montgomery,** who writes from Nepal that he bicycled through Africa, worked in Botswana as a high school math teacher, and was a systems analyst for the Botswana Ministry of Education. He then joined the Peace Corps in Nepal, where he has been since September 1988. He writes, "We had three months of training in Nepali language, culture, and the education system. I had to read, teach and write in Nepali script. At first it was virtually impossible, but with a daily regimen of 30 minutes of studying Nepali during my first year working here, it has gotten easier." Layton then became a secondary school teacher for sixth grade science and eighth grade math. The language difficulty and 60 to 80 students per class keep him very busy. In his spare time, he helps friends with Nepali development projects, and he works on the Peace Corps Advisory Council. "I live and work in Dhulikhel, a town of 6,000, popular with tourists, which is 30 miles east of Katmandu. For Nepal it is a fairly developed town. We have electricity, public water taps throughout town that run for two to three hours per day, and varying forms of toilets for 40-50% of the population. The taps in town are generally for the women, so I have to walk to a spring 20 minutes from my room to bathe. Cooking is such a hassle, and food in local rice shops is so cheap, that I almost never fire up my stove except to boil drinking water or make myself a cup of coffee." Layton is considering extending his contract in Nepal through December 1991.

Hazelyn Patterson works for NASA in Huntsville, Ala. She is the material laboratory engineer on the Internation Microgravity Laboratory and other Spacelab missions. Hazelyn reports that Huntsville is seriously dull, but she has four horses and four cats to keep her and her feed bills company. . . . **Scott Leonard** writes that he recently moved from General Motors Marketing

and Product Planning Staff in Detroit to General Motors European Headquarters in Zurich, Switzerland. Scott's on a special assignment that should keep him busy for a few months. . . . **Kim Clinton** lives in Austin, Tex., but will move back to Vermont in July 1990. Kim works part-time for H & R Block while on maternity leave. She had a girl, Michelle, in September 1989 and a boy, Timothy, in September 1988. . . . **Robert Debare** completed a residency in general internal medicine at Rhode Island Hospital and signed up for a year of locum tenens.

David desJardins has become an accomplished duplicate bridge player after several otherwise unproductive years of graduate school. He works at the Center for Communications Research in Princeton, N.J. . . . **Henry Gonzalez** is on a one-year assignment at the Naval Sea Systems Command as the Navy's program engineer on the joint DARPA/Navy Unmanned Undersea Vehicle Program. . . . **Bruce McHenry** writes software on a ranch near Palo Alto, Calif., and looks forward to bringing an audio server to market this year. . . . **Lyman Hurd** received his Ph.D. in mathematics from Princeton, where he met his wife Susan Greenthal and stepson Daniel. They have a 3-year-old son named Glen Quincy and recent addition Jonathan Matthew, who was born last year on his daddy's birthday. The Hurds live in College Park, Md., where Lyman has a post-doc with the Chaos group at the Laboratory for Plasma Research, and Susan works as a labor and delivery nurse. . . . **Rhonda Brown** and husband Richard Novo, '82, live in Winchester, Mass. Rich works at Ultratech Stepper in Andover, and Rhonda is looking for work at a biotechnology company. . . . **Steve Kim** is a resident in general surgery at Barnes Hospital at Washington University in St. Louis.

Congratulations to Richard and **Valerie (LeMay) Teal** on the birth of Richard Scott Teal, Jr., on March 16. Rich and Val say that Jr. is adorable and already runs the house. . . . **Julie Tiao** was promoted at Bolt, Beranek and Newman. I think she runs a project to build the biggest, fastest, most parallel computer ever. . . . *The Wellesley Townsman* reports that **Mark Brownawell** has been appointed engineering vice-president of General Eastern Instruments of Watertown. Mark has been with GEI since graduation.

I just finished my last final at b-school and am off to Europe. Next issue, we start the Lost Classmate program. If you are looking for classmates and can't find them, send in their names and we will ask the readership to help locate them.—**Jonathan Goldstein,** secretary, TA Associates, 45 Milk St., Boston, MA 02109

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Roy Turnbull works for TRW Vehicle Safety Systems on passenger side airbag systems. He is also working toward an MBA at the University of Michigan (in the evening). . . . **Selina Lin** is halfway through internship in OB/GYN. She thought all-nighters at MIT were tough, but taking night call and working 36 hours straight makes all-nighters seem like cake. But she really enjoys the work. . . . **Thomas Hermitt** lives in New York, works for DEC, and is trying to figure out who the Grateful Dead are and why they keep following him around. . . . **Philip Soo** works for DEC in Chapel Hill, N.C., where he bought a house. He plans to do a lot of windsurfing on the North Carolina coast this summer. . . . **Thomas Clarke** lives in North Cambridge and works at Kendall Square Research, building a supercomputer. . . . Deborah (Meinholz), '85, and **John Rice** had a daughter, Hannah Marie, in September. . . . **Preston Kemp** received a master's degree from RPI in December, and is now a research engineer for Michelin Americas Research in Greenville, S.C. . . . I saw **Neal Kavesh** recently. He is happily married and continuing his medical training. . . . Ken Zeger reports that **Leola Alfonso** and Mike Reese, '85, are married and living in Santa Barbara, Calif.

Chunka Mui reports on a number of classmates: **Sho Fuji** married Jaime Shaffer last September, and they enjoy the great Northwest. Sho works at Boeing's High Tech Center on high-speed devices and is studying Japanese. . . . **Mark Chase** has completed his Air Force stint; his last assignment was at McGuire AFB in New Jersey. He promptly packed all his belongings into his Honda and sped across the country to California, where he is a flight instructor in the Bay area. . . . **Alfredo Tamura** finished three years with NEC in Japan, and is now studying international business at the London School of Business. His old Baker house roommate **Suresh Subramanian** works on software development issues, to revolutionize the way Baby Bells develop software, at Bellcore in Piscataway, N.J. . . . **Nora Ryan** paid her dues as an engineer, got an MBA, and is now product manager at LSI Logic. Rumor has it that her new Miata cruises through Silicon Valley at light speeds. . . . **Chunka Mui** is with CSC Consulting, which brings him close to his MIT haunts: He spends much of his time in the heart of Kendall Square, just a stone's throw from his old Senior House dorm room.—**Howard Reubenstein,** secretary, 38 Belknap St., Somerville, MA 02144, (617) 625-9299, hbr@ai.mit.edu

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Midori Yenari finished her internship at the Hospital of St. Raphael's in New Haven, Conn., in July. She began her residency in neurology at Stanford University. . . . **Kentaro Horiuchi** graduated from Albert Einstein College of Medicine in May 1989. He is finishing his internship in internal medicine at the Bronx Municipal Hospital Center. He will continue on to do a residency in anesthesiology. He married Wendy Tso, an attorney, May 6, 1990.

David Karohl has returned from three years in Brussels. He is now at Interox (Solvay) America as a senior process design engineer in peroxygen products (Persalts). . . . **Jeffrey Bell** is still bicycling and canoeing from time to time. . . . **Peter Tzanetos** is living in Hartford, Conn., and working as a quantitative analyst for Aetna Bond Investors. . . . **Tim Sullivan** searched Grand Rapids, Mich., for 15 months to find an engineering position. In July 1989, he began working as a systems engineer for Smiths Industries. His department designs mission computers for cockpit navigation of military and commercial transports and fighter aircraft.

Sara Keagle Cooke and David Cooke, '83, had their first baby last March. Her name is Merrit Elizabeth. . . . **Jeet Singh** is working at Boston Technology in Kendall Square. It is a small company that is the leader in voice mail systems for both private business and central office. Business is good. He spends time writing and recording music in the MIT Media Lab with classmate **Joe Chung**. . . . **Alec Atkin** is still in Osaka and is working for the Japanese CNC Grinding Machine Manufacturer. His job takes him all over. At the beginning of April, he had to go to Italy, and two weeks later he was in Taiwan. In August, he is expecting to go to India. He bought a motorcycle and has been using it to go to work, which saves half the time of the company bus. However, last January he crashed it; the bike slid and got stuck under the back of a parked truck, and his hand was run over by the last wheel of a semi. Amazingly, he got up without any scratches or bruises either to his body or hand! He only had a small tear in his jeans. Stephanie Taddy, '88, is still in Tokyo, and they've been keeping in contact.—**Stephanie Winner,** secretary, 1026 Live Oak Dr., Santa Clara, CA 95051

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Guess what? We're just about a year from our five-year reunion. Keep that in mind when you're making plans for next June. **Thomas Kurfess** writes from Carnegie Mellon, where he is an assistant professor in mechanical engineering and engineering and public policy. He and his wife Adriana, '87, have just been appointed house masters at the new dorm on campus, beginning in May. This is a new "experimental" position that has never been tried before, and they're both excited about being involved from the beginning. If anyone is interested in getting hold of Tom, his e-mail address is trk@edrc.cmu.edu.

Renton Carsley is a lieutenant in the U.S. Navy, stationed at NAS Pensacola, Fla. He is a flight instructor for student naval flight officers. He will be married July 1, 1990, to Leigh Grossman (Wellesley, '89). . . . **Lisa Bell** is currently a member of the Technical Staff, KDT Industries, Inc. in Austin, Tex. Her current project is doing operations analysis for NASA/JSC (OAET Planetary Surface Systems) Human Exploration Initiative, that is, lunar and Mars program development. . . **Todd Tsakiris** is working as a senior research scientist at Optron Systems, an electro-optics research and development contracting firm in Bedford, Mass.

Scott Saleska recently began a new job as staff scientist at the Institute for Energy and Environmental Research, a non-profit public policy organization in Washington, D.C.

Jon Hirschtick is the founder and president of Premise, Inc., a software company located in Kendall Square (since 1987). He is engaged to Melissa Hatch and will be married May 20, 1990. Jon recently moved to Winchester, Mass., and is living across the street from Bob Karp, '82, and his wife Andrea Schievella, '88. . . . **William Shyu** is working in the Mathematical Science Research Center at AT&T Bell Labs in Murray Hill, N.J. He works in the scientific visualization computer graphics area. He also pratices Chinese Shoolin Martial Arts and the violin in his spare time. William's wife, Chinny Yue, '87, also works at AT&T Bell Labs in Holmdel, N.J. . . . **Robert Ambrogi** is doing mechanical engineering work for Hughes Aircraft in El Segundo (just down the street from me) and has married a "Yalie" turned UCLA law student (on March 31, 1990).

Robert Lenoil is extremely busy working on a "fantastic" product at Apple as well as getting an MBA at night and performing and teaching improv with Comedy Sportz. Robert still finds time for hiking, biking, and cross-country skiing, including a stay at the MIT Outing Club cabin in Intervale last Christmas. He's starting to think about his five-year sabbatical next year: his current plan is to go to Africa and climb Kilimanjaro. Also, Robert has resumed his hang gliding lessons and, last summer, went bungee cord jumping off a bridge—the "most incredible rush he's ever felt." Finally, his old racquetball partner, **Mike Konopik** has moved to Mountain View, Calif. (where Robert is) where he will be working for SRI.

Lt. **James Person,** U.S. Navy, writes during one of his deployments again. He was gone from November 1989 to May 1990. He spent some time in the Persian Gulf (a lot more quiet than last time) and in Hong Kong where **Suzanne Dunbar** was able to meet him. James and Suzanne were married July 22, 1989, in San Diego. **Mary (Bayalis) Prettyman, Ginny Agresti, Lauren Singer, Gabrielle Hecht, Bill Hobbib,** and **Dennis Arnow** attended. Class of '87 attendees included Jon Athow and Jim Janowski. They honeymooned by driving up the California coast to Monterey, Calif. Then Suzanne returned to work at General Dynamics, where she is a business planner in the Space Systems Division, and James returned to the Navy. During his deployment, Suzanne met him in Phuket, Thailand, and they proceeded to Bangkok and Hong Kong, where they both took advantage of all the outlet stores there. James bought some new suits to begin civilian life. He's leaving the Navy in June 1990. (I guess those six month trips at sea aren't all that appealing anymore). . . . **Chris Medina** has caught the same civilian fever. He dropped me a line from the

U.S.S. Merrill (also James' ship). Chris made lieutenant last August and was married to Karla Kramer (UC/San Diego, '89) on February 4, 1989. After Chris gets out in June, he intends to get into technical sales and marketing or project engineering. Meanwhile, Chris' current job is main propulsion assistant or "to keep the screws turning and the lights burning."

Rich Maurer and **Karl Tucker** came out to visit me. Rich was attending a course at Castle AFB in northern California, probably something to do with flying since that's what Rich does in his real life—flies tankers at Griffiss AFB, N.Y. Anyway, we went to Mom's in Westwood and had a few beers. . . . **Mark "Bismark" Emineth** is out on business for six weeks, and we took him out to Toe's Tavern, a local surfer's bar, and had a few beers. Mark had just spent a month in the San Francisco area visiting **Anne Fricker.** . . . Finally, I played in a four-man beach volleyball tournament (with Rob Dare, '84), and we took second out of 17 teams. Boy, did we all get fried. (For those non-Californians, that means sunburnt.) Until next time.—**Mary C. Engebreth,** secretary, 1800 Hermosa Ave., A, Hermosa Beach, CA 90254

87

It's hard to believe that three years have past since graduation. Of course, it would be a little easier to believe if you knew what all your classmates had been up to out there in the "real world." Now is the time to send in those letters so that I can spread the word and relieve your old buddies of their present state of obliviousness.

I'm hoping that **Lindy Elkins** is only the first of many '87 grads to write in with the latest information. Last year, Lindy was living in Ithaca, N.Y., where she was publisher of a wine magazine. She married Curtis Bohler, then a Cornell PhD student. Lindy and her husband now live in Washington, D.C., where Curt works with Senator Bill Bradley, and Lindy is working for *U.S. News and World Report*. One of their latest adventures was with the MIT alumni/ae group in D.C., a fossiling field trip!

Bruce Bigby, Somerville, Mass., is currently working as a software engineer, focusing on compiler development, at Compass, a subsidiary of Softech, Inc.

Chuck Jones, Ann Arbor, Mich., married Daphne Dwyer, Wellesley, '89, last summer at Wellesley College. Chuck left his investment banking job at Merrill Lynch to pursue a PhD in finance at University of Michigan, while his wife is attending medical school at U of Michigan. According to Chuck, "School is great, but the Midwest is boring. Oh well, only three years left."

And now for some news on the homefront, LIP-NOSE and beyond. **Anthony Scotti** will be making his way to Washington, D.C., to attend George Washington University. . . . **Janet Zahradnik** will be starting her second year at Boston University Medical School. . . . **Marci Hecker** is enjoying her work in public policy research at Abt Associates. . . . **Gary Rohrbacher** is designing for Add, Inc. . . . **Dan Kennedy** is working for Oracle. . . . **Lowell Kim** is working for Cambridge Technology Group. . . . **George "Mike" Cathey** will be getting a master's of computer science from the Institute and is deciding where to begin his career. . . . **Rich Roth** is still working on a PhD in materials science. . . . And, I am graduating from the J.F. Kennedy School of Government, soon to be a public employee (I think). . . . An adjunct Lip-nosian, **Dave Chen,** has just moved to Virginia to work for Arthur Anderson.

That is all the information you are going to get for now. I'm counting on you for help with the next issue. The only other thing I have to say is ENJOY THE SUMMER!—**Stephanie Levin,** secretary, 41 Prentiss St., Cambridge, MA 02140, (617) LIP-NOSE

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I received unfortunate news of the passing of **Georgette Louise Redmond** at the National Institute of Health, Bethesda, Md., in late February. Georgette, a physics major at MIT had just completed her first year of graduate school at the University of Michigan where she was pursuing her doctorate in physics. We offer our sincerest condolences to family and friends.

Tim Benner sends news of some Conner III alumns. Tim decided to take some time off after graduation and joined the Navy. After extensive training, he worked at a Navy nuclear power training unit. There he learned to operate a nuclear reactor and associated propulsion plant. At the beginning of March 1990, he moved to Newport, R.I., for Surface Warfare Officer School and was there until the end of July. From there he went on a ship, the *U.S.S. Arthur W. Radford* out of Norfolk, Va., to "do some real work." He keeps in touch with **Bill Jonsson,** who is engaged to be married to Beth Cohen, '91, in January 1991. Bill, a Navy ROTC, has been on the *U.S.S. Nicholson*, a Spruance class destroyer out of Charleston, S.C., his hometown. He is presently in the Persian Gulf. . . . **Wendy Liu** is currently spending a year in Japan with NEC, having left last September. . . . **Maddelena Coppi** is studying biology at Harvard.

Navy Ensign **Christopher Cook** has been designated a naval flight officer. He received his "wings of gold" upon completion of the 23-week navigator training course at Mather Air Force Base in Sacramento, Calif. . . . **Chris Saito** is also a navy flight officer. He is currently receiving training in flying Intruder A-6E's. If any of you have seen the movie, *Flight of the Intruders,* that's what he's flying. Very impressive!

Franco DeAngelis is working as an electrical engineer for Martin Marietta in Denver. He enjoys the area very much. . . . **Gail Sadlo** is still working at Boeing, but took a leave of absence during the summer of 1989 to participate in a U.S./U.S.S.R. peace project in Armenia, U.S.S.R., and Yakima, Wash. . . . **Emilio Cacciavillani** is currently employed as an associate medicinal chemist at SmithKline and Beecham Clinical Labs in King of Prussia, Pa., working on their AIDS Protease Inhibitor project. He is planning to return to graduate school this fall for his PhD in organic chemistry at UC/Irvine.

Suzy Soffler is in her second year at Pratt Institute in New York, "desperately pursuing a master's of industrial design." She plans on finishing in January, "assuming she doesn't drown in her new responsibilities as news editor of the school paper." She saw some MITers at a party in late March at **Audra Noel**'s apartment in New Jersey. Audra is attending med school. Among those who attended were **Dara Norman** (working at Goddard Space Labs), who drove up from DC; Alison Lynch, '89, and Jen Kwo, '86, who drove down from Boston; and **Ignace Kuchazik.** It turned out that the life of the party was a giant snapping turtle, who apparently made his way through the bathroom wall from an adjacent apartment and fed on the bathmat. Go figure. If any of you think you can top that story, or just want to shoot the breeze, drop me a line. Hope you all had great summers; we'd love to hear about your escapades! *Note new address:* **Grace Ma,** secretary, 545 1st Ave., 9H, New York, NY 10016

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Tomas Saulys has been TAing a course in the University of Wisconsin Computer Science Department. As part of his work, he consults in the computer lab and checks programs. Tom hopes to take up windsurfing or sailing this summer, and will complete a master's degree in the fall. . . . **Mark Metz** lives and works in Karlsrune, West Germany. . . . **Scott Schwartz** works for 3M as an engineer and has started a master's degree at the University of Minnesota. . . . **Laura Ryzowicz** works at Textron Lycoming in Stratford, Conn., where she has been learning about turbine engine cooling in the rotational engineering training program. She plans to marry Mark Rapacioli, '87, in August.

Kyle Robinson married Maureen Brown last December in Washington State. **Rob Introne, Dan Teal,** and **Ken Dinndorf** attended. Kyle is starting pilot training at Williams AFB in Arizona. Rob finished up a master's degree at Georgia Tech. Dan is at Kelly AFB, Tex. Also at Kelly is **Ken Bennett,** who was at Wright Patterson AFB in Dayton, Ohio, attending a class.

Sandy DeVincent was married in July to Tom Moynihan. **Alice Mendelsohn** and **Teri Centner** (who passes along much of this month's news) were bridesmaids. The wedding was in a family church in Waltham, although Sandy has been studying for her PhD in metallurgy at Case Western. Alice is in grad school at Northwestern, and Teri is at Wright Patterson AFB in Dayton, Ohio.

Maged Elmenshawy is pursuing an MS at Stanford, along with **Mike Finke.** Mike finished early so he could get to Euro/NATO joint pilot training at Shepperd AFB, Tex. . . . **Joe Orso** and **David Fleming** are at University of Maryland in the aero/astro program. . . . **Charles Whetsel** is looking seriously into grad school, but is still at JPL with **Alan DiCicco.** . . . **Karen Koyama** is in Los Angeles working at TRW in Redondo Beach. . . . At Castle AFB, Calif., **Christina Vilella** is a tanker maintenance officer. She says the nightlife is a far cry from that of Boston, and anyone passing through Merced should give her a call. . . . **Cheryl Blake** is at Griffiss AFB in upstate NY, where she enjoys meeting new people and participating in many sporting activities. . . . Visiting **David Schulman** at the University of Florida in February was **Chris Walton,** vacationing from his job at Raytheon. Dave plans to take the physics qualifying exams in August. It rains horizontally in North Central Florida, Dave says, which makes umbrellas about as useful as crossbow expertise.

Ron Koo took a plant trip to California, where he was hosted for dinner by **Bill Maney. Phil Kuhn, John Flight,** and **Angeli Salgado** were also at the dinner party. Bill works at Maxim and plays in a band. Phil and John, who room together, work at Oracle. In his spare time, Phil coaches Little League.

Lori Tsuruda and **Jonathan Monsarrat** plan to marry at the Trinity Church in Copley Place at the end of July, and have planned a Hawaii honeymoon. They have been living in Brighton for the past year, and Jonathan has been working at Cadence Design Systems, Inc., in Lowell, while Lori has been studying cell biology at Tufts. Lori and Jonathan attended the April ball in honor of President and Mrs. Gray. Lori was excited to hear about the Public Service Center's summer fellowships and endowment, things once on the "wish list" when Lori, Mrs. Gray and I were on the Public Service Steering Committee. Attending the ball from his home base of Menlo Park, Calif., was **Yee Ung,** who has been working at Oracle and traveling all over the world. . . . Lori also writes about some of her fellow APO members: **Andrew Tomkins,** who received the MIT chapter's Distinguished Service Key, was visiting MIT from Carnegie-Mellon. . . . **Mary Condello** and **Sally Vanerian** have been spotted around the Tufts Med School/Sackler School of Biomedical Sciences campuses. . . . **Laura Baldwin** is in the Tufts immunology program.

Lori Aronson writes that she and **Mark Anderson** have gotten engaged. They plan a June 1991 wedding in Philadelphia. Lori is finishing her first year of med school at Case Western Reserve University in Cleveland, and Mark is working on his PhD in Political Science at Harvard. Lori says that **Carlos Barreto** works on fuel injectors for Ford in Ann Arbor.—**Henry Houh,** secretary 5380 Hollow Dr., Bloomfield Hills, MI 48013, tripleh@athena.mit.edu

COURSE NEWS

I CIVIL ENGINEERING

Michael A. Collins, PhD '70, writes: "After 20 years on the engineering faculty of Southern Methodist University, I have accepted a position as senior project manager with Woodward-Clyde Consultants, consulting engineers & environmental scientists, in Baton Rouge, La., where I head up the newly formed water resources group." . . . **Robert J. Degon,** SM '68, reports: "I retired from the U.S. Navy last December and am now working for Industrial Design Corp., a Portland, Ore., E/A firm specializing in high-tech industries." . . . **Stuart A. Batterman,** PhD '86, is now at the University of Michigan's School of Public Health in Ann Arbor. . . . **Alberto B. Calvo,** SM '72, of Newton, Mass., has been promoted to division staff analyst at TASC Logistics Engineering Group. . . . **Paul Roberts,** SM '57, is president of Transmode Consultants, Inc., in Washington, D.C.

Peter S. Eagleson, ScD '56, MIT's Edmund K. Turner Professor of Civil Engineering, has been elected a Fellow of the AAAS at its annual meeting in New Orleans. . . . **Richard S. Ladd,** SM '66, laboratory director for Woodward-Clyde Consultants in Clifton, N.J., has been elected chair of Committee D-18 on Soil and Rock of the American Society for Testing & Materials (ASTM). He will lead the 710-member standards-writing committee for a two-year term. . . . The National Academy of Engineering has re-elected **George Bugliarello,** ScD '59, president of Polytechnic University, Brooklyn, N.Y., for a three-year term as councillor of the NAE. . . . **Cranston (Chan) R. Rogers,** SM '51, has been appointed VP and director of transportation design at the Massachusetts office of Maguire Group, Inc. He will be responsible for marketing and administering transportation design services on a company-wide basis. Rogers has more than 39 years of engineering experience that includes acting as a designer of Boston's Central Artery in the 1950's. He most recently served as design manager for a portion of the Central Artery reconstruction project.

Camp Dresser & McKee, Inc., has made two alumni appointments. **Myron S. Rosenberg,** PhD '77, has been appointed VP and **Robert P. Schreiber,** SM '76, has been appointed an associate. Rosenberg specializes in the remediation of underground contamination from hazardous materials, serving as CDM's senior specialist on underground storage tank management projects. He is currently involved in CDM's major environmental assessment project for the Massachusetts Department of Public Works Central Artery/Third Harbor Tunnel Project. Schreiber is a team leader with expertise in the analysis and modeling of groundwater flow and contaminant movement and has served as the director of groundwater modeling on several major projects. He has developed original computer programs to model groundwater flow in three dimensions, to simulate water quality, and to store and display hydrogeologic and groundwater data. . . . **Robert Karasek,** PhD '76, and Tores Theorell have written *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life* (Basic Books, 1990). Karasek is associate professor of industrial & systems engineering at the University of Southern California and is currently visiting professor of psychology at Aarhus University in Denmark.

Simpson Gumpertz & Heger, Inc., Engineers/Architects, a consulting firm in structural and earthquake engineering, building technology, architecture, and related fields, announces the promotion of **Rene W. Luft,** ScD '71, to principal. Luft has been with the firm since 1971 and he will continue to be based in its San Francisco office. According to a company press release, "he has been instrumental in the development and upgrading of seismic codes nationwide. He has worked since its inception in formulating the National Earthquake Hazards Reduction Program, Recommended Provisions for the Development of Seismic Regulations, and recently directed studies for upgrading numerous large structures in California following the October 1989 earthquake." . . . **Gavin Finn,** SM '85, a consulting engineer with the Stone & Webster Engineering Corp., has been selected as the Young Engineer of the Year by the Metropolitan Chapter of the Massachusetts Society of Professional Engineers. The award is presented annually to an engineer under the age of 35 in recognition of his or her professional, civic, and scholastic accomplishments. Finn is the youngest person in Stone & Webster history to be promoted to the level of consulting engineer.

II MECHANICAL ENGINEERING

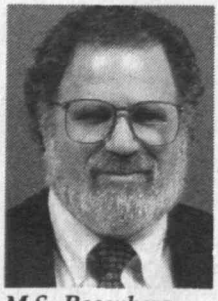
Craig Gardner, SM '89, of Danvers, Mass., writes: "Professor Richard Lyon, PhD '55 (VIII), and I are co-inventors of a new vibration-damping technology on which MIT has applied for a patent. The invention is based on my masters thesis. This technology is suitable for damping vibrations in ships, buildings (including earthquakes), heavy equipment, and automobiles. MIT has granted me an exclusive license and I am now trying to market the concept." . . . **Albert Dyrness,** SM '86, reports: "Three partners and I have formed an engineering consulting firm on the West Coast called Advent Engineering Services. We provide consulting services to the energy industry. The excitement of being an entrepreneur is something that everyone should experience!" . . . From **Joanne M. Higgins,** SM '76: "I have just undergone an internal company transfer to the Health & Environmental Laboratories of Eastman Kodak Co. I am working as a senior environmental engineer in incineration technology, where my graduate work in combustion at MIT is being fully utilized."

James H. Kennedy, SM '50, owner of Kennedy Publications, a producer of books and newsletters about executive recruitment, was recently the subject of a local newspaper article. The *Keene Sentinel* ran a feature on Kennedy and his "other" head collection. Since his specialty is known in the business world as "headhunting," he has also managed to collect about 40 sculptures of heads in stone, clay, coconut, etc. "Secretly I'd like to have a real shrunken head, but I know they're illegal," Kennedy jokes. "Friends of mine said, 'The only one we'd like to see there is your own.'" . . . **Keith Morris,** SM '82, writes: "I am currently living in Japan, working for a joint venture company. I recently formed a new company with five other people called Assurance Technologies, Inc. (ATI), which specializes in automation and quality control devices. I am the technical marketing manager. We will return to the U.S. this August with a new addition to the family—made in Japan by Americans!" . . . **William T. Townsend,** PhD '88, married Julianne Barrett last September. They manage two companies in Cambridge and plan on staying in the area. . . . In November 1988, **John F. Howard,** SM '68, became president and CEO of American Electronic Components, Elkhart, Ind. . . . Draper Lab employee **Edward Kingsbury,** ScD '57, has been appointed to the Fellows Committee of the Society of Tribologists and Lubrication Engineers.

Marvin Goldstein, SM '62, chief scientist at NASA's Lewis Research Center, was recently elected to the National Academy of Engineering (NAE) for "his outstanding theoretical contributions in the area of aerodynamics, acoustics, and unsteady aerodynamics for advanced aerospace propulsion systems." Goldstein joined Lewis 22 years ago after teaching at MIT. . . . The Boston Museum of Science has named **George N. Hatsopoulos,** '50, as its 1990 Inventor of the Year. Founder, chair, and CEO of Thermo Electron Corp. of Waltham, Mass., Hatsopoulos is recognized by the museum for his contributions to the fields of science and technology, environmental protection, business, and international exchange. His company produces products that help to solve major social problems: the radon detector, portable bomb detector, drug detector, heart-assist device for cardiac patients, energy-saving cogeneration equipment, and a machine that cleans gaso-

R.S. Ladd

C.R. Rogers



M.S. Rosenberg

R.P. Schreiber

M.E. Goldstein

W.H. Ware

line and chemical contaminants from the soil. Thermo Electron . has recently received the "Corporation of the Year" award from *R&D* magazine, and Hatsopoulos has been named *New England Business'* "Business Person of the Year," and *Inc.* magazine's "Master Entrepreneur."

Captain **Thomas R. Eddy,** SM '47, USN (Ret.), of Pleasant Hill, Calif., died on October 14, 1989. No further information was provided.

III MATERIALS SCIENCE AND ENGINEERING

Alan Huelsman, PhD '88, and Catherine Jessel, SM '88 (XV), were married last September in Cleveland, Ohio. They now reside in Woodland Hills, Calif. . . . **Janine J. Weins,** PhD '70, is president & founder of Your Idea, a business that sells intellectual self-help information. . . . On July 1, **John F. Watton,** ScD '87, became chair of the department of mechanical engineering at Lawrence Technological University in Southfield, Mich., where he had done his undergraduate work. . . . **Don Ritter,** ScD '66, U.S. Representative for Pennsylvania's 15th District, was presented with the American Association of Engineering Societies Chairman's Award. The honor is given to an individual who "has applied his or her engineering skills to the benefit of our country andthe engineering profession." Ritter was recognized for "encouraging America's involvement in leading-edge technologies and promoting quality to improve our nation's competitiveness." . . . **John W. Lane,** '73, has been promoted to VP for technology at the Hartford, Conn., headquarters of Aerospace Metals, Inc., a group of companies whose primary business is recycling and stocking aerospace metals.

Richard T. Newberg, PhD '72, of Sudbury, Mass., died on March 5, 1986. No further information was provided.

IV ARCHITECTURE

George B. Thomson, '49, writes: "Although a 'special' student and never a full-fledged member of the MIT community, I enjoyed and profited from my several terms in planning and architecture six years after Harvard. The experience and guidance proved useful in design and development work during the 1950's until accidental involvement in public affairs (local government and the Massachusetts General Court) which led to 15 years as a bureaucrat, primarily in the administration of various state planning programs (transportation, regional affairs, and solid waste) before 'retirement' to New Hampshire in '78." . . . **R. Christopher Mathis,** SM '82, reports: "I recently joined the staff of Architectural Testing, Inc.,(ATI), of York, Pa., as VP and director of marketing. ATI is a laboratory specializing in evaluating the performance of building facades, particularly for air infiltration, water leakage, structural performance, etc. The lab includes thermal testing and accelerated aging equipment for windows. I have published two papers on the performance and testing of loose-fill insulations for ASTM publications. I am currently working on a paper on field testing of commercial building skins and am also involved with a program to develop a national rating system for the performance of fenestration products."

Norma F. Satten, MCP '45, sends word from San Francisco: "I am now retired from full-time employment but continue consulting part-time in health care administration & planning. I visited the Soviet Union last fall and hope to go again. I paint in my spare time." . . . MIT Urban Studies and Planning Visiting Lecturer **Peter Droege,** MAR '78, was featured as a keynote speaker at a Dutch conference on telematic technology and urban change organized by the City of Amsterdam, the Chamber of Commerce, and the Province of North Holland. His March 15 presentation was entitled "Intelligent Cities: Countervailing Forces." Last January he made a presentation at the Jakarta "Southeast Asian City of the Future" conference, sponsored by the Aga Khan Program for Islamic Architecture and the Indonesian Association of Architects. . . . The Bronx Museum of the Arts sponsored a competition called "Visions of the Home: Designs for Affordable Housing in the South Bronx." Third Prize and $1,000 was awarded to **Nandinee Phookan,** SM '87, **Kazi K. Ashraf,** SM '88, and Luis Rivera for "a scheme which reintroduced ornament, symbol, and figure into the public realm," according to a museum press release. "Their comprehensive design for the whole site proposed a new and subtle expressiveness for urban architecture." Phookan, from India, was with the Housing & Design unit and Ashraf, from Bangladesh, was with the Design for Islamic Societies unit.

V CHEMISTRY

Philip E. Rakita, PhD '70, has accepted a position as department head of industrial chemicals for Atochem, the chemical branch of Elf Aquitaine (the French national oil company) located in Paris. He will be there on a three-year assignment. . . . **James D. Burrington,** PhD '77, was named university research coordinator for BP Research, Warrensville Research Center, Cleveland, Ohio. . . . **Dana Mayo,** '52, professor of chemistry at Bowdoin, is a co-winner of the Bowdoin Prize, the college's highest honor, for his work in "developing the microscale organic chemistry apparatus and curriculum that is being adopted all over the country." . . . **Lloyd Currie,** '52, has received the U.S. Commerce Department's Gold Medal, its highest honor, for "insightful seminal contributions to measurement science in atmospheric chemistry and the evolving field of chemometrics."

MIT Chemistry Department Head and Professor **Mark S. Wrighton** was the consulting editor of *General Chemistry,* Third Edition (Houghton Mifflin, 1990). . . . **Edward R. Kane,** PhD '43, former president of E.I. du Pont de Nemours & Co., Inc., Wilmington, Del., was re-elected for a three-year term as treasurer of the National Academy of Engineering. . . . NYGene Corp. of Yonkers, N.Y., founded by **Frank Brunetta,** '49, has introduced the AutoMASS 1000 system. According to a company press release, "this system, a completely automated membrane affinity separation system that drastically reduces the time and costs of purifying monoclonal antibodies and other biopharmaceuticals used in the detection, diagnosis, and treatment of cancer, AIDS, and other diseases," promises to have a major impact on the time and costs of biomolecule separation.

The Alumni/ae Association has been notified of the following deaths: **Alan L. Kling,** '37, of Jamesburg, N.J., on February 3, 1990; **John M. Mochel,** SM '43, on July 27, 1989; and **Ellen M. Mochel,** SM '49, in July 1984. The Mochels resided in Ojai, Calif. No additional information was provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

From Burnaby, British Columbia, Canada, **Paul S.K. Wong,** SM '74, writes: "After working for B.C. Hydro (an electric power company) for 16 years, I started my own consulting engineering firm, WL Energy System Technologies, Inc., in January 1990. The company specializes in on-site investigations, measurements, and computer simulation of the electric power system. Areas of expertise include: electric and magnetic field effects; power-line audible noise, radio and television interference; control cable interference; and power system unbalance and harmonics." . . . In 1985, **Irwin Mark Jacobs,** ScD '59, co-founded Qualcomm, Inc., in San Diego, Calif. The company has won one of the few government contracts for development of high-definition television, and it is also working on a technology that could relieve the crowding of cellular bands by creating a new standard for the medium. It is also involved in satellite communications for the trucking and railroad industries. All this from a retired University of California engineering professor! . . . Ernst & Young and the National Center for Computer Crime Data have awarded to **Willis H. Ware,** SM '42, the Conscience in Computing Award. Ware, who works for Rand Corp. on the corporate reseach staff, is the first recipient of this award. He is widely known for his work on the technical and policy issues associated with efforts to secure the nation's commercial and military computers.

Stephen Angelovich, SM '62, of Yonkers, N.Y., died on March 15, 1990. In 1956 Angelovich joined Duracell, Inc., as an engineer and in 1979 was named VP of technical operations, a job he held until his death at age 51.

VI-A INTERNSHIP PROGRAM

Director **Kevin J. O'Toole,** NE '57 (XIII), reports that VI-A has experienced another successful recruiting period selecting the VI-A Class of '90. The new class numbers 86, picked from among 156 applicants; that is, 60 percent of the Course

VI sophomores applied and 55 percent of those were selected—maintaining the percentages of recent years. For the first time this class will have students participating in the newly formed Consortium for Superconducting Electronics. Two will be associated with IBM and two will be with MIT's Lincoln Laboratory.

Graduates of the Program continue to be honored for their contributions to our field of engineering. **Harold Chestnut,** SM '40, (IEEE Fellow) has been awarded one of two 1990 IEEE Service Awards, the Richard M. Emberson Award, for "leadership and dedication to the Institute's technical growth and service worldwide, and for the development of systems engineering concepts." After retiring from General Electric Co. in 1983 with 40 years of service, he helped establish the Swiis Foundation which seeks ways to identify and implement supplemental ways for improving international stability.

Two other graduates have been elected to membership in the National Academy of Engineering: **Irwin Dorros,** SM '56, (IEEE Fellow) and **Robert H. Kingston,** SM '48, (IEEE Fellow). Dorros is also the recipient, this year, of a 1990 IEEE Engineering Leadership Recognition Award. He created the technical services program at Bellcore, a program he continues to direct as executive VP. The IEEE award recognizes him for "outstanding leadership in the creation and management of Bell Communications Research, Inc." I had the pleasure of his support in adding Bellcore to VI-A back in 1985, following the AT&T divestiture. Kingston, a senior staff member and former group head at MIT's Lincoln Laboratory, is currently an adjunct professor of electrical engineering in the EECS Department.

Elected to the National Academy of Sciences is **Lawrence R. Rabiner,** PhD '67, (IEEE Fellow). Larry is head of the Speech Research Department at AT&T Bell Laboratories. He has maintained his interest in VI-A and has selected a number of our students to work in his area at Bell Labs over the years.

I'm also honored to report that your correspondent, **John A. Tucker** Hon '85, has been selected to appear in the 1990 Marquis publication *Who's Who in the East.* Back in my undergraduate days of 1948 I was elected to appear in *Who's Who Amongst Students in American Universities & Colleges.*

On campus April 9, 1990, was **William B. Lenoir,** PhD '65, associate director of NASA's Office of Space Flights. Bill was a mission specialist on the shuttle *Columbia's* flight in November 1982 and was here for a talk sponsored by the MIT Space Grant Program to generate student interest in affiliation with NASA and to report on future plans. Bill spoke for an hour in 10-250 and then left for the next day's launch (subsequently aborted) to put the Hubble telescope in orbit. He and I had a friendly chat prior to his talk.

Among 1990-91 officers for the MIT Chapters of the honoraries Tau Beta Pi and Eta Kappa Nu are a number of VI-A's. The treasurer of Mass. Beta Chapter, Tau Beta Pi, is **Todd H. Rider,** '90.

Those serving Beta-Theta Chapter, Eta Kappa Nu, will be: President, **Bradford T. Spiers,** '91; Vice-President, **Christine L. Tsien,** '91; Treasurer, **Vijay Balasubramanian,** '91; Corresponding Secretary, **Sanjeev Agrawal,** '91; Recording Secretary, **Alice A. Chang,** '90; and Members-at-Large **Lars E. Bader,** '91, **Federico A. Garcia,** '91, **Scott D. Hector,** '90, and **Scott E. Sikora,** '90.

VI-A'rs heard from or who visited the VI-A office, since last writing, included:

Thomas Durgavich, SM '76, who has been consulting with a group in our Laboratory for Computer Science; **Steven K. Ladd,** SM '81, who has moved back East from the West Coast to Hudson, Mass., where he's eastern regional sales manager with Advanced Packaging Systems, a Raychem Co.; **Ho John Lee,** SM '85, who's now president of Tetra Systems, Inc., of Palo Alto, Calif., an independent engineering consulting firm specializing in advanced capabilities for cost-effective technical supercomputing in a desktop environment; **Wendy Peikes,** '76, who called to say she had rental space for new VI-A's coming to the Santa Clara, Calif., area this summer and that she has left H-P to be with Rational, Inc.; and **Thomas R. Shiple,** SM '87, who was here for a conference and stopped by, and expects to be attending the University of California at Berkeley in the fall for his studies towards a PhD.—John A. Tucker, Director (Emeritus) VI-A Internship Program, MIT, 77 Mass. Ave. Rm 38-473, Cambridge, MA 02139

VII BIOLOGY

Jack Nelson Lindon, PhD '74, writes: "In January 1989, I accepted the postion of Baxter research scientist with Baxter Healthcare Corp. in Round Lake, Ill. . . . **Kevin Struhl,** '74, professor of biological chemistry at Harvard Medical School, has been chosed to receive the Eli Lilly & Co. Research Award. The award consists of a bronze medal and $5,000. Struhl's "ability to design crucial experiments, testing them by a combination of molecular and genetic methods, has been of notable merit in the fields of microbiology and biochemistry." According to a press release, "he was the first to demonstrate that an eukaryotic gene could function in a prokaryotic host, something many scientists did not believe possible. The major focus of his current work is transcriptional regulation, understanding the regulation of eukaryotic genes in molecular terms."

Professor **Philip A. Sharp,** director of the Center for Cancer Research at MIT, has been appointed to the board of directors of The Medical Foundation, a United Way agency that operates programs to support biomedical research fellowships and programs of health education and prevention. . . . **Susumu Tonegawa,** Nobel Prize laureate and professor of biology also at the Center for Cancer Research, has received the Rabbi Shai Shacknai Award from the Hebrew University of Jerusalem. The prize is given annually by the university's Lautenberg Center for General and Tumor Immunology to an "outstanding world figure in immunology and cancer research." . . . **Lisa A. Steiner,** professor of immunology at MIT, has been elected a Fellow of the American Association for the Advancement of Science.

VIII PHYSICS

John Thomas Armstrong, PhD '83, writes from Alexandria, Va.: "I'm working at the Naval Research Lab and the U.S. Naval Obervatory on observations with the optical interferometer on Mt. Wilson, Calif., and on designing a bigger and better optical interferometer, probably to be built in Arizona." . . . A course called "The Music of China and Japan" was offered last spring by the department of music at the University of California at Davis. The class was taught by visiting professor **Bell Yung,** PhD '70, associate professor of music at the University of Pittsburgh who has studied and written extensively about Asian music and is regarded as one of the country's foremost authorities on the subject. Yung is the founder and director of the Association for Chinese Music Research and has served as council member for the Society for Ethnomusicology. He is the author of *Cantonese Opera: Performance as Creative Process,* (Cambridge University Press, 1989).

Boston Business Journal recently published a biosketch of Telco Systems, a Norwood, Mass., company that manufactures fiber-optic and digital transmission equipment. Highlighted was **Paul D. Lazay,** PhD '69, president and CEO. He has been with the company for five years and is credited with three fiber-optic-related patents. . . . **June L. Matthews,** PhD '67, and **Alan H. Guth,** '68, both

MIT professors of physics, were elected Fellows of the American Association for the Advancement of Science.

The Alumni Association has been notified that **Sergio Vazquez,** of Tampa, Fla., died on April 2, 1990. Vazquez, who died in an automobile accident in Washington State, was a 28-year-old doctoral candidate in Course VIII.

IX BRAIN AND COGNITIVE SCIENCES

William E. Cooper, PhD '76, writes: "I am currently dean of the College of Arts and Sciences and professor of psychology at Tulane University in New Orlean, La."

X CHEMICAL ENGINEERING

John, ScD '83, and **Gina Nenniger,** ScD '86, send word from Calgary, Alberta, Canada: "Our company, Nenniger Engineering, Inc., continues to grow. We are excited about some of the new areas/projects that we are expanding into. After moving our lab three times during the past year, we have just settled into completely renovated and permanent lab facilities. Things have been a bit hectic lately with the arrival of our second daughter, Elizabeth Dianne, on January 28." . . . **John H. Lutz,** ScD '43, reports: "Our winter residence on St. John (U.S. Virgin Islands) was effectively wiped out courtesy of Mr. Hugo. After a winter of furious and exhausting activity—not to mention scouring up craftspeople and writing checks, we at least have a habitable residence. We look forward to a restful summer in Maine." . . . **Edward Rolfe,** SM '51, writes: "Currently very active as a consultant in the design of distributed management, production, & marketing information systems, operating on wide- and local-area computer networks. I am forming a corporation to develop and market related software & hardware. Growth will be based on technology development and planned acquisition, with private sector funding. Contacts are invited from individuals and corporations."

Oak Ridge National Laboratory (ORNL) has two employees who have recently been distinguished. **Murray W. Rosenthal,** ScD '53, deputy director of ORNL, has been elected to membership in the National Academy of Engineering. Rosenthal was cited for "outstanding leadership of nationally important energy technology R&D programs in fission, fusion, coal, conservation, and renewable energy." . . . **Victor Vaughen,** '56, director of the Office of Safety and Operational Readiness for the Chemical Technology Division of ORNL, was named Outstanding Engineer of the Year by the Tennessee Society of Professional Engineers. He has worked in the nuclear energy fields of fuel processing, isotope production, and nuclear waste handling. Most of his contributions have been in peaceful uses of nuclear energy ranging from designing equipment for remote hot cell operations to setting research agendas and directing experimental studies for the reprocessing of irradiated nuclear fuels.

PerSeptive Biosystems, Inc., is a new Cambridge-based company "committed to the development of bioseparation products for the biotechnology and pharmaceutical industries." The company's founder **Noubar Afeyan,** PhD '87, states in a press release: "Our R&D team is second to none. We have leaders in protein chemistry, surface chemistry, polymer science, biochromatography, and bioprocess engineering." Joining the firm as VP of marketing and systems development is Scott Fulton, '75 (VIII). Joining the R&D efforts at the company is **Neal Gordon,** PhD '89, a chemical engineer from the MIT Bioprocess Engineering Center. He is the manager of the Chromatographic Systems Group at PerSeptive.

XI URBAN STUDIES AND PLANNING

Kerry D. Vandell, PhD '77, writes: "Last September I was named professor and chair of the Department of Real Estate and Urban Land Economics at the University of Wisconsin at Madison." . . . MIT Urban Studies & Planning Visiting Lecturer **Peter Droege,** MAR '78 (IV), was featured as a keynote speaker at a Dutch conference on telematic technology and urban change organized by the City of Amsterdam, the Chamber of Commerce, and the Province of North Holland. The title of his March 15 presentation was "Intelligent Cities: Countervailing Forces." Last January he made a presentation at the Jakarta "Southeast Asian City Of the Future" conference, sponsored by the Aga Khan Program for Islamic Architecture and the Indonesian Association of Architects.

Knowledge and Public Policy: The Search for Meaningful Indicators, Second Expanded Edition (Transaction Publishers, 1990) by **Judith Eleanor Innes,** PhD '73, has just been released. Innes is a professor in the city and regional planning department of the University of California at Berkeley. According to its dust jacket, "this book addresses the question of what it takes to develop social indicators that genuinely influence important public decisions. It looks historically at the processes of creating and using three important social indicators in the U.S.: unemployment rates, standard budgets, and crime rates. It then develops principles for choosing concepts, designing measures, and creating policy processes that institutionalize their use." . . . **Maryann McCall-Taylor,** MCP '80, has announced that she is seeking re-election to the Winchester, Mass., planning board. She has served on the board for the last six years, including as chair, secretary, and vice-chair.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Marilyn M. Wolfson, PhD '90, writes: "After receiving my PhD last February, I have returned to the staff of Lincoln Lab. I am working on the FAA Terminal Doppler Weather Radar Project, and will be participating in an operational demonstration of the TDWR system in Orlando, Fla., this summer." . . . **Pam Melroy,** SM '84, of Bossier City, La., sends word: "Last year the Air Force nominated me for mission specialist to NASA. I didn't make it, but I plan to try again next year."

XIII OCEAN ENGINEERING

Captain **Lawrence K. Donovan,** SM '71, reports: "Bechtel has transferred me to the Gaithersburg, Md., office from San Francisco to be the first regional manager for the Defense and Space Project. My wife Judi and I are living in North Potomac, Md." . . . Captain **John H. Sweeney,** NE '60, USN (Ret.), is now director of education at the Charles Stark Draper Lab. He and his wife Nancy are living in Cambridge.

The Alumni/ae Association has been notified that **Edmund E. Brady,** SM '21, of Washington, D.C. died on February 15, 1975. No further information was provided.

XIV ECONOMICS

From Santa Barbara, Calif., **Stephen J. Decanio,** PhD '72, writes that he served as a member of a U.N. panel of experts reporting on economic aspects of the Montreal Protocol on "Substances that Deplete the Ozone Layer." The panel's report was one of several technical studies conducted in preparation for meetings that will be held in 1990

to revise the Montreal Protocol. . . . Batterymarch Financial Management has announced that **David S. Scharfstein,** PhD '86, is one of three winners of their fellowship program. He will receive a stipend of $60,000 to support one year of academic research during which he will be freed of teaching and administrative duties. The awards are given to non-tenured faculty with the requirement that research undertaken during the one-year time period must be publicly available. Scharfstein is an MIT School of Management assistant professor of finance.

Robert L. Price, is director of the office of COCOM affairs at the Department of State and is responsible for policy on multilateral trade controls in high technology toward the USSR, Eastern Europe, and the People's Republic of China. . . . **Andrei Shleifer,** PhD '86, University of Chicago professor in the Graduate School of Business (GSB), has been awarded a $25,000 Sloan Research Fellowship. Shleifer is an economist whose special interest is mergers and acquisitions. Working with GSB colleague Robert Vishny, Shleifer has shown that targets of hostile takeovers are not just poorly performing businesses, but tend to be industries in decline. He has also studied the relation between the management ownership and market valuation and various aspects of industrial development. He is currently editor of the *Quarterly Journal of Economics.* Last year he won a Presidential Young Investigator Award from the National Science Foundation.

Paul Krugman, PhD '77, has written *The Age of Diminished Expectations: U.S. Economic Policy in the 1990s* (The Washington Post Co., 1990). Krugman, professor of economics at MIT, has been a consultant to the International Monetary Fund, the World Bank, the United Nations, the Trilateral Commission, and the U.S. State Department. . . . Two alums have contributed to *Technology Transfer in the Developing Countries* (St. Martin's Press, 1990), edited by Manas Chatterji. **Shinichi Ichimura,** PhD '53, vice-chancellor of the Institute of International Relations, Osaka International University, contributed a chapter entitled "Appropriate Technologies in Southeast Asia." **Khalid Saeed,** PhD '81, associate professor of system dynamics and management at the Asian Institute of Technology, contributed a chapter entitled "Prevention of Dysfunctional Environmental and Social Conditions in Technology Transfer."

XV MANAGEMENT

Demie Stathoplos, SM '83, writes: "After six years at MCI Communications Corp. in finance and most recently marketing, I left my position in April 1989 to take time off to do volunteer work. In January 1990, I was hired as executive director of Washington D.C.'s Habitat for Humanity, a non-profit organization that builds affordable housing. I love the work and I feel like I'm making a contribution to improving the world." . . . **Rene A. Smith,** SM '78, sends word: "I am serving as president of the MIT Club of San Diego for 1989-1990. I just started as sales manager with Voice & Video, a local company meeting the audio and video needs of San Diego's businesses." . . **Claudette M. Fisher-Johnson,** SM '88, has moved to London to take a job with Bankers Trust. Her husband will be going to London Business School. . . . **Michael Connolly,** SM '82, writes: "I'm taking six weeks off from work as human resources director at the AIDS Action Committee in Boston to visit my brother and sister-in-law in Lubumbashi, Zaire. Yippee!"

Karen C. Evans, SM '87 is "still working at Strategic Planning Associates, but in July will be moving to San Francisco. I'm also still whitewater rafting and, in dry weather, mountain biking is my new interest." . . . **Jason S. Rubin,** SM '84, sends word: "I was recently promoted to VP of Hill & Knowlton, Inc., a leading public relations/public affairs consulting firm." . . . **Catherine Jessel,** SM '88, and Alan Huelsman, PhD '88, (III) were married in September 1989 in Cleveland, Ohio. They now reside in Woodland Hills, Calif. . . . Skadden, Arps, Slate, Meagher & Flom has named **Marco E. Schnabl,** SM '73, a litigation lawyer, as a new partner in its N.Y. office. The international law firm has about 1,050 attorneys, including 223 partners, in 12 offices worldwide. . . . **Thomas P. Gerrity,** '63, president of CSC Consulting, a Computer Sciences Corp. group, has been named dean of the University of Pennsylvania's Wharton School. Gerrity, a Rhodes Scholar, will became the eleventh dean of the nation's oldest collegiate school of management on July 1, 1990. He has spent 20 years consulting with senior executives in the United States and Europe on the strategic role of information technology. In 1969, while a faculty member at Sloan, he founded Index Group, which is now a part of CSC Consulting.

Technology Marketing Group, Inc., cofounded in 1984 by **Leslie Clift Hruby,** SM '73, and F. Michael Hruby, has been designated as one of the 100 leading management consulting firms in the United States by *Consultant News,* a monthly newsletter that covers the consulting profession. TMG, based in Acton, Mass., specializes in industrial marketing. The firm has "extensive experience in specialty materials, equipment, and components, technical services, and various esoteric things ranging from software to cement to swizzle sticks." . . . Merck & Co. has appointed **Judy C. Lewent,** SM '72, as CFO in charge of $2 billion in investments and pension funds at the phamaceutical company. The appointment puts Lewent, who was also named VP for finance, among a small group of women to be appointed CFO of a major U.S. corporation. Lewent joined Merck in 1980 as director of acquisitions and capital analysis. . . . Greystone Technology Corp. has hired **Ellen Siever,** SM '77, as product manager. Siever has more than twenty years of software development experience, most recently at Adelie Corp.

The Alumni/ae Association has been notified that **David M. Carney,** '73, of Cambridge, Mass., died in 1985. He had participated in the Urban Executive program at the Sloan School.

Sloan Fellows

Matthew E. Anderson, SM '80, sends word: "I was selected for the President's Executive Exchange Program. I am taking a one-year leave of absence from my position as associate technical director at the Naval Weapons Center, China Lake, Calif., to work in the advanced products, technology & engineering department of Xerox Corp. in Rochester, N.Y. The program includes seminars in Washington D.C., at Harvard, and a three-week trip to Europe to discuss EC-'92 with representatives of seven countries." . . . **Irv Skorka,** SM '69, writes that he is "responsible for productivity activities at Loral Electronic Systems in Yonkers, N.Y., and as part of the effort, is involved in establishing a continuous improvement initiative in the division. Improvement in quality leads to productivity improvement and the division becomes more competitive," he adds. . . . **Victor L. Peterson,** SM '73, was named deputy director of NASA's Ames Research Center. Peterson has served as Ames' director of aerophysics since 1984 and he has served as the center's acting deputy director in 1988 and 1989. He was one of the originators of the NASA initiative to develop the Numerical Aerodynamic Simulation System, the leading computational resource for the nation's aerospace program.

Ford Motor Co. reorganized its corporate strategy office and named **William C. Ford, Jr.,** SM '84, previously head of heavy-truck engineering and manufacturing, to oversee strategic planning for world-wide auto operations. The promotion is the second in less than a year for Ford, a great-grandson of the company's founder. . . . The *Hunterdon County Democrat,* Flemington, N.J., ran a profile on **Daniel Hesse,** SM '89, last March.

The article focused on Hesse's trip to Japan while researching his thesis, entitled "The New Strategic Complexity: Nippon Telegraph and Telephone's Dilemmas and Opportunities." He came away from Japan with a better understanding of the Japanese business style and its integral link with the culture.

Management of Technology Program

Victor M. Aguado, SM '82, is now executive VP for engineering systems at ISDEFE in Madrid, Spain. He has held this position since January. . . . **Jerome P. Sutton,** SM '83, became the deputy program director of the Advanced Medium Range Air-to-Air Missile (AMRAAM) Program office last November. He is working at Eglin Air Force Base in Florida. . . . **Bruce Gobioff,** SM '84, has recently begun work in Munich, West Germany, as manager of test support and control of the Amadeus Project at IBM Corp. . . . **Eugene W. Huang,** SM '85, is district manager of Glasrock Home Health Care in Milford, Conn. He has been in this position since May 1989.

Jay Herther, SM '86, was promoted in January to program manager of SEEK SPARTAN at Lockheed Sanders, Inc., in Nashua, N.H. He is currently trying to launch a small company called Pinnacle Systems, Inc. . . . **Katherine Rowe,** SM '86, and her husband, Steve Fox, proudly announce the arrival of Laura Christine Fox, born on February 28, 1990. They are "getting a real kick out of learning to be parents!" . . . **Remolo Ciola-Filho,** SM '87, is the assistant to the president at the Institute Cientificos CG, Ltda., in Sao Paulo, Brazil, a position he has held since February 1988. He sents his best regards. . . . **Margery L. Pruessner,** SM '87, is an advisory engineer at IBM in Cary, N.C. She's been in this position since August 1989. She also got married to **Fred George,** SM '87.

Malcolm Sims, SM '87, has been general manager of the Innovation Centre of BP Ventures in Langley, England, since mid-1988. He says that the Innovation Centre promotes the development, pre-production, and early stage marketing of new products and services of technology-based business ventures. . . . **Neil Slavin,** SM '87, has been a chief engineer at Analogic Corp. in Peabody, Mass., since April, 1989. . . . Since May 1989, **Robert L. Capell III,** SM '88, has held the position of director of national services with Bellsouth Services, Inc., in Atlanta, Ga. . . . **Thomas A. Gardner, Jr.,** SM '88, is an executive officer with the USS *Norfolk* and has held that position since September 1989. The home port of the ship is Norfolk Naval Base in Virginia. . . . **Arthur R. Laney,** SM '88, was named manager of industrial engineering of Schlumberger Well Services Manufacturing in Houston, Tex., in February 1990. He and his wife Lisa had their second child, James Wesley Radford Laney, on September 8, 1989.

Rick Amerson, SM '89, is working as section manager at Hewlett-Packard in Cupertino, Calif., a position he took in June 1989. . . . **Alexander Clelland,** SM '89, is chief of avionics integrity with the U.S. Air Force at Wright-Patterson Air Force Base in Ohio. He has held this position since July 1989. . . . **Kenji Nozaki,** SM '89, will become senior mechanical engineer of the Design Division at Shimizu Corp. in Tokyo, Japan, in June of 1990. . . . **Brian J. Truskowski,** SM '89, became the administrative assistant to the IBM VP & general manager, Application Business Systems, at IBM in Somers, N.Y., in January 1990. He will be getting married to Terry in November 1990, in Rochester, N.Y.—Kathy Abourached, Management of Technology Program, Room E52-125, Cambridge, MA 02139

XVI AERONAUTICS AND ASTRONAUTICS

Claude W. Brenner, '47, of Lexington, Mass., who has served as president of the MIT Alumni/ae Association and on the MIT Corporation, has been elected president of the board of directors of MIT Hillel Foundation, Inc. . . . Two MIT alums' honors were mentioned in the March edition of *D Notes,* a publication of Draper Lab: **Jay Lala,** ScD '76, has been elected a Senior Member of the IEEE. Only about 8 percent of the IEEE's members have been elected to that grade. **David Hoag,** '46, was one of the sources for an article entitled "Moon Landing" included in an NAE publication entitled *Engineering and the Advancement of Human Welfare: 10 Outstanding Achievements 1964-1989.* . . . **Peter F. Lorber,** PhD '84, was one of 17 United Technologies Research Center scientists and engineers cited by the center for their extraordinary technical achievements and contributions during 1989. Lorber, a research engineer, served as principal investigator and co-director of a major experimental program to measure the performance and flight characteristics of a one-fifth scale Sikorsky UH-60A Black Hawk helicopter rotor in hover and in forward-flight condition, among several other key accomplishments.

E. Eugene Larrabee, SM '48, Course XVI professor emeritus, sent a letter to *Tech Talk:* "Aeronautics lost one of its most fervent devotees on March 1 when **Walter Mooney,** '50, died at his desk at GD-Convair in San Diego. He was a founding member of the Tech Model Aircrafters in 1947, and he built model airplanes continuously, especially free-flying scale model airplanes limited to a wing span of 13 inches called 'Peanut Scale.' His association with man-carrying aircraft began in 1950 at the Helio Aircraft Corp. in Norwood, Mass., where he participated in the development of Professor [Otto Karl] Koppen's Helioplane Courier. An accomplished aviator, he flew everything from sailplanes to kit-built airplanes such as the Volksplane. He owned a Piper Vagabond, which might be characterized as an immense model airplane in which the balsa sticks have been replaced by steel tubes. He held the unofficial record for consecutive loops in the Mooney (no relation) Mite airplane. Finally he named his children after airplanes—Curtiss Ryan, Douglas Martin, and his daugher Chrislea Bea, the last after an obscure English lightplane. Hundreds of aeronautical enthusiasts the world over who have built peanut scale models from the many plans he published will miss him most." Larrabee, by the way, was a co-founder of the Tech Model Aircrafters along with Mooney.

T.P. Gerrity

L.C. Hruby

J.C. Lewent

P.F. Lorber

XX APPLIED BIOLOGICAL SCIENCES

Irene Gennett, PhD '89, sends word from Colchester, Vt.: "I am currently working as a postdoctoral fellow with Dr. Webster K. Cavenee at the Ludwig Institute for Cancer Research in Montreal, Quebec. I recently spent a month in Siena, Italy, teaching molecular genetic techniques at both the University of Siena and Solavo, Inc. This collaboration will result in setting up Italy's center for analysis of retinoblastoma and related eye disorders." . . . **Dominick P. DePaola,** PhD '74, has been unanimously affirmed as the new president and dean of Baylor College of Dentistry in Dallas, Texas. DePaola, currently dean of the dental school at the University of Medicine and Dentistry of New Jersey, will join Baylor in August 1990. He has been very active in research and has been personally responsible for the acquisition of $1.5 million in research and training grants. DePaola is currently serving as president of the American Association of Dental Schools.

XXI HUMANITIES

Southern Exposure, a magazine published in Durham, N.C., has been awarded the National Magazine Award in the Public Interest category for a three-article issue on the corporations that control the American broiler chicken industry. **Barbara Goldoftas,** SM '82, who teaches in Harvard's expository writing program and has contributed to *Tech Review,* wrote the story for the publication. Goldoftas contends that half the brand-name chickens that arrive in consumers' refrigerators are contaminated with salmonella, largely because the assembly-line workers handle at least one bird every second of every minute of every eight-hour shift. She says she hasn't turned vegetarian, but she hasn't bought a factory-processed chicken since last summer.

XXII NUCLEAR ENGINEERING

James H. Wicks, Jr., SM '87, was promoted to Commander, U.S. Navy. He is currently serving as a nuclear repair officer at the Pearl Harbor Naval Shipyard in Hawaii. . . . **Henri Fenech,** PhD '59, professor of nuclear engineering at UC/Santa Barbara, will serve for two years beginning July 1, 1990, as director of the University of California education abroad program in the centers of Lyon and Grenoble, France. . . . **William T. McCormick, Jr.,** PhD '69, is a contributor to *Energy: Production, Consumption, and Consequences* (National Academy Press, 1990), edited by John L. Helm. McCormick is chair of the board and CEO of CMS Energy Corp. and its principal subsidiary, Consumers Power Co. His chapter is entitled "The Uncertain Future Role of Natural Gas."

TPP TECHNOLOGY AND POLICY PROGRAM

Kent Hughes, SM '85, has a new position in the Sales and Marketing of Central Office Software Division of Northern Telecom, Inc. . . . **David O'Dowd,** SM '89, has recently joined the staff of Temple, Barker, and Sloane, Inc. . . . **Jean Briskin,** SM '83, was recently appointed to direct the EPA's National Pesticide Survey: a project to determine the national occurrence of contamination by pesticides and nitrates of groundwater used for drinking, and to quantitatively assess the factors that lead to contamination. . . . **Steven Stewart,** SM '85, had an addition to his family: daughter Kelly Marie arrived on May 30, 1989. Older sister Erin will soon be three. . . . **Janet Schaab,** SM '80. recently had an addition to her family. Kristen Michelle was born in March.—Richard de Neufville, TPP, Room E40-252, Cambridge, MA 02139

E. Francis Bowditch, 1913-1990

Francis Bowditch, dean of students at MIT from 1951 to 1956, died of congestive heart failure on February 6 in Boca Grande, Fla. He was 77 and resided in Boca Grande and Madison, Conn.

A graduate of Milton Academy and Harvard College, Bowditch served as headmaster of two independent schools before coming to MIT and became involved in scientific research after leaving the Institute. He was the first leader of the Society for Creative Altruism in 1957 and the author of *New Knowledge in Human Values*, published in 1958.

Deceased

The following deaths have been reported to the Alumni Association since the *Review* last went to press:

Julian E. Adler, '13; April, 1990; Birmingham, Ala.
Earle R. Lincoln, '13; December 23, 1980; Vancouver, B.C., Canada
Maurice T. Root, '14; April 23, 1990; Rockland, Maine
Arthur J. Hartsook, '20; March 23, 1990; Houston, Tex.
Henry C. Nelson, '21; January 23, 1990
John B. Starkweather, '22; December 24, 1989; Orinda, Calif.
Kenneth G. Crabtree, '23; February 13, 1990; Ellsworth, Maine
Einar A. Hanson, '23; March 30, 1990; Delray Beach, Fla.
Frank Miller, II, '23; March 28, 1990; Middlebury, Conn.
Leander H. Poor, '23; April 15, 1990; Hightstown, N.J.
Mrs. Paul Caskey, '24; January 3, 1990; Rockford, Ill.
Herbert C. Moore, '24; October 25, 1989; Newtonville, Mass.
Mrs. Robert G. King, '25; 1989; Sarasota, Fla.
William Muschenheim, '25; February 1, 1990; Ann Arbor, Mich.
Katherine H. DeWolf Pendlebury, '25; March 31, 1990; Bristol, R.I.
Raymond N. Rowe, '25; April 6, 1990; Colebrook, N.H.
F. Martinez Carbajal, '26; 1989; Vizcaya, Spain
Ralph E. Colclesser, '26; April 6, 1990; Stuart, Fla.
Alonzo W. Ruff, '26; March 26, 1990; York, Penn.
Edward T. Dunn, '27; February 14, 1990; Hockessin, Del.
John J. Campobasso, '28; April 18, 1990; Georgetown, Mass.
Richard B. Goble, '28; January 12, 1989; Irvington, Va.
Edward J. Wood, '28; January 11, 1990; Green Valley, Ariz.
Aaron Bornstein Brandon, '29; April 22, 1990
Samuel A. Janney, '31; August 2, 1988; Gloucester, Va.
Ivanhoe P. Denyssen, '32; 1990; Montreal, P.Q., Canada
Marion H. Hartshorne, '32; May 10, 1988; Hamilton, N.Y.
William D. Harper, '33; March 6, 1990; Hattiesburg, Miss.
Niazi I. Mostafa, '33; April, 1989; Cairo, Egypt
Walter F. Swanton, '33; January 19, 1990; Rochester, N.Y.
Nembhard N. Culin, '34; March 9, 1990; Vineyard Haven, Mass.
Edward S. Rand, '34; March 14, 1990; Scituate, Mass.
John V. Salo, '34; March 19, 1990; Goffstown, N.H.
Leslie E. Richardson, '35; April 26, 1990; Alexandria, Va.
Frank P. Wilkins, '35; April 15, 1990; Lexington, Mass.
Paul D. Mulkern, '36; February 19, 1990; Brandon, Fla.
Raymond C. Svenson, '36; April 3, 1990; Mendon, Mass.
Ross E. Black, '37; April 4, 1990; Waterford, Conn.
James M. Freiberg, '37; December 31, 1984; New Kensington, Penn.
Alan L. Kling, '37; February 3, 1990; Jamesburg, N.J.
John S. Bethel, Jr., '38; April 10, 1990; Boxford, Mass.
Mrs. John (Ellen) M. Mochel, '38; July 1984; Ojai, Calif.
George S. Weems, III, '38; May 19, 1989, Fairhope, Ala.
Alexander P. Hrennikoff, '40; January 1, 1985; Vancouver, B.C., Canada
Stanley F. Luce, '40; October 9, 1989; Marion, Mass.
Stewart E. Miller, '40; February 27, 1990; Locust, N.J.
Mary B. Rahn, '40; June 19, 1989; Boston, Mass.
H(ollis) Garrett Wright, '40; November 11, 1989; Springfield, Mo.
William C. Muir, '42; September 15,1989; Waltham, Mass.
Robert B. Norris, '42; May 13, 1989; Storrs, Conn.
Martin R. Smith, '42; May 9, 1989; Houston, Tex.
Robert W. Maxwell, '43; November 24, 1989; Stuart, Fla.
John M. Mochel, '43; July 27, 1989; Ojai, Calif.
Warner B. Smith, '43; October 24, 1989; Lake Wales, Fla.
Robert J. Dew, Jr. '44; June 24, 1989; Indialantic, Fla.
Lee C. Eagleton, '44; May 15, 1990; State College, Penn.
H(enry) Philip Whitaker, '44; November 29, 1989; Weston, Mass.
Kenneth H. Fischbeck, '45; September 29, 1989; Hanover, N.H.
Donald M. Whitehead, '45; March 25, 1990; Paxton, Mass.
Arthur E. Buller, '47; June 5, 1989; Victoria, B.C., Canada
Robert N. Creek, '47; September 28, 1989; Inverness, Ill.
Soli D. Dubash, '47; March 24, 1987
Robert F. Wadsworth, '47; November 17, 1988; Los Alamitos, Calif.
Harold A. Knapp, Jr., '48; November 8, 1989; Germantown, Md.
James J. Pastoriza, '48; October 15, 1989; Lincoln, Mass.

Robert J. Collins, '49; February 26, 1989; Ann Arbor, Mich.
Nisson A. Finkelstein, '49; October 24, 1989; Wilmington, Del.
Dale E. Lockard, '49; January 3, 1989; Mechanicsburg, Penn.
Charles B. Reimer, '49; July 28, 1989; Decatur, Ga.
Howard A. Reuter, '49; September 23, 1989; Pasadena, Md.
Paul J. Ahearn, '50; March 24, 1990; Belmont, Mass.
Jacob G. Bartas, '50; September 15, 1989; Southbury, Conn.
Raymond M. Brown, Jr., '50; 1987; Hampton, Va.
William N. Johnston, '50; September 7, 1989; Short Hills, N.J.
Walter E. Mooney, '50; March 1, 1990; San Diego, Calif.
Richard J. Powell, '50; September 26, 1989; Lynbrook, N.Y.
Roger N. Saleeby, Jr., '50; October 12, 1989; Cos Cob, Conn.
Frank T. Weems, '50; October 15, 1989; Los Altos, Calif.
David G. Hammel, '51; November 27, 1989; Sherborn, Mass.
Allen L. Shields, '52; September 16, 1989; Ann Arbor, Mich.
William B. Smyth, '52; April 21, 1990; Winston Salem, N.C.
William G. Aubruner, Jr., '53; February 20, 1990; Hammond, Ind.
Hans S. Buch, '53; January 12, 1989; Soborg, Denmark
Frank Norman Grimsby, '54; July 11, 1989; Houston, Tex.
Richard J. Hayes, '54; November 7, 1989; New Canaan, Conn.
Terrance R. Palmer, '54; September 4, 1989; Waldorf, Md.
Judson S. Ball, '55; January, 1989; Evergreen, Col.
Bernhard W. Romberg, '56; October 23, 1989; New York, N.Y.
Roy F. Thorpe, '58; September 10, 1989; Denville, N.J.
Herbert J. Blaha, '59; April 13, 1989; San Antonio, Tex.
Harold O. Flynn, '61; December 20, 1988; Cadillac, Mich.
Wesley M. Maulden, '61; May 16, 1989; Seattle, Wash.
Paul M. Pitts, '61; January 20, 1989; Sanibel, Fla.
John P. Shannon, '63; September 2, 1989; Escondido, Calif.
Joseph J. Poli, Jr., '64; July 29, 1989; Ridgewood, N.J.
Gary N. Solomon, '72; July 10, 1989; Delray Beach, Fla.
Allan Y. Teranishi, '73; March 9, 1982; Berkeley, Calif.
Robert Anthony Beh, '74; September 5, 1989; Somerville, Mass.
Gilbert F. De Bartolo, '76; October 19, 1989; Bedford, Mass.
Joe T. Shelton, '79; October 8, 1989; Houston, Tex.
Werner Grune, '81; September 8, 1988, Andover, Mass.
Brian W. Stoddard, '87; September 21, 1989; St. Marys, Ga.
Christopher McTee, '88; October 21, 1989; Cambridge, Mass.
Sergio Vazquez, '90; April 2, 1990; Tampa, Fla.

ALLAN J. GOTTLIEB, '67

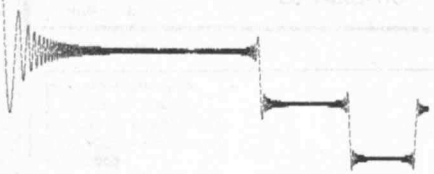
Auld Lang Sine

Readers interested in Rubik (and other) puzzles might wish to contact Peter Beck at Just Puzzles, 54 Richwood Place, Denville, N.J. 07834. Robert High suggests that those interested in the game of Go contact the American Go Association, P.O. Box 397, Old Chelsea Station, New York, N.Y. 10113.

As we reported last month, "Puzzle Corner" is being phased out due to increased pressure for space in the alumni section of *Technology Review* and the next issue will contain the last installment of this column. As a result there are no new problems this month.

Solutions

APR 1. We begin with a computer-oriented problem from Jim Landau who wants you to write a program that generates (a reasonable facsimile of) the following graphic output.



Richard Hess observed that the graph looks like a partial Fourier expansion of a step function

$$\sum_{k=1}^{n} \frac{1}{2k+1} \sin(2k+1)\pi x.$$

Winslow Hartford's function was

$$ke^{-g(x)x}\cos(f(x)\cdot x + \varphi),$$

where k, g, f, and φ are determined by curve fitting. Ken Rosato's function was

$$A(x) + B(x)\cdot\cos(C(x)),$$

where again A, B, and C are parameters. The proposer's solution, which appears below, is rather different and includes some "Puzzle Corner history:

This program was written in an unsuccessful attempt to solve a Puzzle Corner problem (I don't have the number, but it appeared in 1986 ± 1) which asked for the curve generated by the integral from 0 to x of sin (t to the nth), where n > 1. The correct answer is a sine-like curve with decaying amplitude and wavelength.

This program attempts to find integral of sin (t to the n) by evaluating t to the n at evenly-spaced intervals and summing the values. This technique works fine if the intervals are small relative to the period of the sine wave.

```
APR 1
    5 INPUT "power of t", N        rem  input the shape parameter N
   10 CLS                          rem  clear the screen
   20 PI = 3.14159265#             rem  set up constants
   30 INC = PI / 360               rem  INC is ½ degree in radians
   40 PI8 = PI * 8
   50 F = 0
   60 FOR T = 0 TO PI8 STEP INC    rem  loop for t from 0 to 8 pi
   70     SINTN = SIN (T^N)        rem  sin (T to the Nth)
   80     F = F + SINTN * INC      rem  add to accumulator
   90     XP = T * 25              rem  convert to PC pixel coordinates
  100     YP = F * 200
  110     PSET (XP, YP)            rem  turn on pixel at (XP, YP)
  120 NEXT T
```

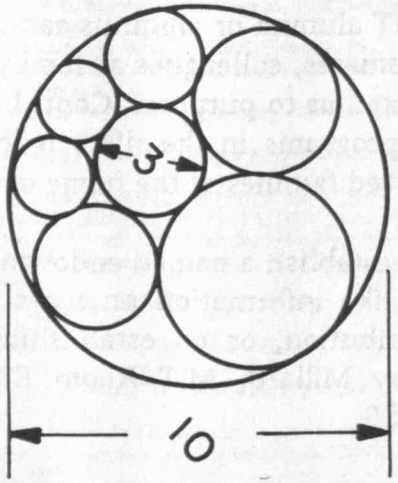
HOWEVER, the sine wave is decaying in wavelength, and eventually the wavelength becomes about as small as the sampling interval, which means the program is now sampling once per wave at roughly the same spot on each wave. Hence the accumulator F, instead of oscillating as does sin (t to the n), becomes monotonic and remains so for a short while, until the wavelength decays even more and becomes less than the sampling interval. At this point the program is sampling from every second wave and is generating reasonable results again for a while, until the wavelength decays to the point where the sampling occurs at almost the same spot on each wave, whereupon F becomes monotonic once again. And so *ad infinitum*.

The program's output is therefore incorrect but when plotted the results are rather pretty and it takes a while to realize that it is preposterous for such a simple function to have such an elaborate graph.

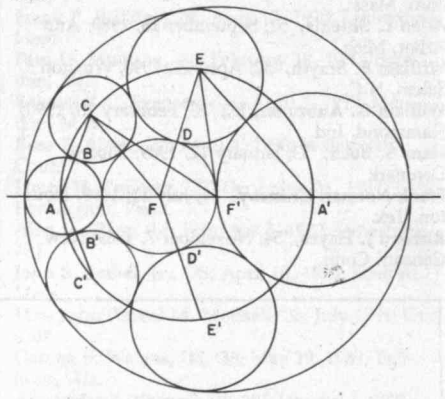
APR 2. Frank Rubin wants the largest prime having a digit that can be replaced by any of the nine other digits with the resulting number still prime.

Matthew Fountain, Robert Bart, Robert High, Avi Ornstein, Richard Hess, Donald Zalkin, and the proposer all observed that no such prime can exist since at least one of the nine results would be divisible by 3. This is so since a number is divisible by 3 if the sum of its digits is divisible by three.

APR 3. Matthew Fountain knows only that the inner and outer circles in the figure below have diameters of 3 and 10 but still wants you to determine the distance between their centers.



The following solution technique was employed independently by Edward Dawson and Eugene Sard:



The center of the diameter 3 circle is at F, the center of the diameter 10 circle is at F', and the distance between these centers, FF', is 1.5. The centers of the six circles between the diameter 3 circle and the diameter 10 circle are on the ellipse ACEA'E'C' which has foci at F and F'. One of these circles, of diameter 2, has its center at A, and one of diameter 5 has its center at A'. The length of the major diameter of the ellipse, AA', is 6.5. The radius, BC, of the circle with its center at C can be obtained from triangles CAF and CAF'. In triangle CAF:

$$AC = BC + 1,\ AF = 2.5,\ CF = BC + 1.5,$$

$$\cos \tfrac{1}{2}\angle CAF = \sqrt{\frac{BC + 2.5}{2.5(BC + 1)}}.$$

In triangle CAF':

$$AC = BC + 1,\ AF' = 4,\ CF' = 5 - BC,$$

$$\cos \tfrac{1}{2}\angle CAF' = \sqrt{\frac{5(BC)}{4(BC + 1)}}.$$

Therefore, as

$$\angle CAF' = \angle CAF,\ \frac{5(BC)}{4} = \frac{BC + 2.5}{2.5},$$

$$\text{and } BC = \frac{20}{17} \cong 1.17647.$$

Likewise, from triangles EA'F and EA'F':

$$\frac{5(DE)}{2.5} = \frac{2.5(DE + 4)}{4},$$

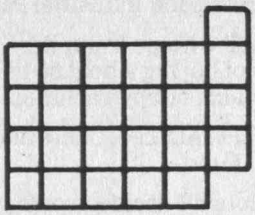
$$\text{and radius } DE = \frac{20}{11} \cong 1.81818.$$

As the ellipse is symmetric in the line AFF'A', radius B'C' = BC, and radius D'E' = DE.

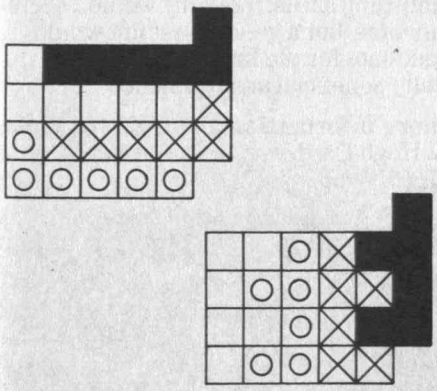
Also solved by Robert Bart, Robert High, Mary Lindenberg, Joe Feil, Harry Zaremba, Richard Hess, Winslow Hartford, Ken Rosato (who solved a more general problem involving n circles), Roy Sinclair, Norman Wickstrand, and the proposer.

SEND SOLUTIONS AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: gottlieb@nyu.edu

APR 4. The following problem appeared in "Golomb's Gambits" edited by Solomon Golomb in the *Johns Hopkins Magazine*. You are to divide the figure below into four congruent pieces. There are two solutions.



The following solution is from Mary Lindenberg:



Also solved by Matthew Fountain, Robert Bart, Robert High, James Walker, Avi Ornstein, Joe Feil, Harry Zaremba, Richard Hess, Winslow Hartford, Donald Zalkin, Ken Rosato, Angel Silva, Alan Taylor, Bill Huntington, and Dan Garcia.

APR 5. Robert Bart's hypertension medication comes in 5 mg. tablets that can be divided in half to give morning and evening doses of 2.5 mg. each. At each dose, Bart selects a pill at random from the bottle. If it is 2.5 mg., it is used; if it is 5 mg., half is used and half returned to the bottle. Ignore size effects, i.e., the chance of getting a large pill is simply the percentage of pills that are large. Originally, Bart has N 5 mg. tablets and he wants to know what is likely to be the number of 5 mg. tablets remaining after i days. More specifically, he wants you to determine $P(n,N,i)$, the probability that n 5 mg. tablets remain after i days of use starting from N 5 mg. tablets and then determine the expected value of n as a function of N and i, i.e.,

$$E_n(N,i) = \sum_n nP(n,N,i)$$

In particular, what is $P(1,N,N-1)$, the probability that the *last* two doses will be a single 5 mg. tablet rather than two 2.5 mg. pieces. If a closed form is not possible, how about numerical solutions for $P(50,100,50)$, $E_n(50,20)$, $E_n(50,40)$, $P(10,20,10)$, and $E_n(10,5)$.

No one was able to obtain a closed form solution. Richard Hess and Steve Feldman each sent in the following numerical solutions based on computer calculations:

$$P(50,100,50) = 4.01368379 \times 10^{-20}$$
$$E_n(50,20) = 20.742281231$$
$$E_n(50,40) = 4.398673692$$
$$P(10,20,10) = 1.6093242 \times 10^{-4}$$
$$E_n(10,5) = 3.02588505$$

Bill Huntington notes that a similar problem occurs in his (dog) house since he has a large and a small dog who need a whole and half pill respectively each day.

Also solved by Matthew Fountain, Robert High, and Winslow Hartford.

Better Late Than Never

1988 F/M 4. Warren Himmelberger notes that Samuel Butler's novel was *Erewhon* and not *Erehwon* as printed. Hence one of the palindromes given was wrong.

1989 N/D 1. Howard Helman notes that in printing his solution various spacings were changed, a few of which resulted in syntactically invalid C programs. Mr. Helman's original solution is available from the editor and I apologize for not catching the errors in the galleys.

N/D 5. Carl Jockusch notes that the independence of the bits is not necessary since the expected value of the sum of random variables is always the sum of the expected values.

1990 JAN 2. Ronald Yoo and James Walker have responded.

JAN 4. Richard Hess has responded.

F/M 3. James Walker has responded.

F/M 5. James Walker has responded.

MIT LIFE INCOME FUNDS

MR. ROBERT W. ADENBAUM

HOME: Jupiter, Florida

CAREER: Born in New York City, Mr. Adenbaum received a bachelor of science degree in administrative engineering from Lafayette College in 1949 and a master's degree in business and engineering administration from MIT in 1950. Shortly afterwards, he was commissioned in the United States Air Force as an industrial planning officer. At the end of the Korean War, he started a plastic molding industrial parts business, later merging with his father's firm, the Accurate Molding Company, which sold custom-molded plastics to manufacturers nationwide.

Mr. Adenbaum was president of Accurate Molding Company until he retired in 1987. He also develops industrial real estate and is president of Palm Beach Industrial Park, Inc.

Mr. Adenbaum recently built a home in Jupiter and is in the process of buying a boat so he can return to his life-long hobby, yachting.

GIFT OF CAPITAL: Leo, Claire and Robert Adenbaum Fund.

QUOTE: Although I decided some years ago that MIT would be a significant beneficiary of my estate, I only realized recently that by establishing a trust, not only would I secure my income, but a greater amount would accumulate for the Institute. It was a mutually beneficial arrangement.

For more information about gifts of capital, call D. Hugh Darden or Frank H. McGrory at MIT, (617) 253-3827.

Photo: Ken Davidoff

DONOR'S PROFILE

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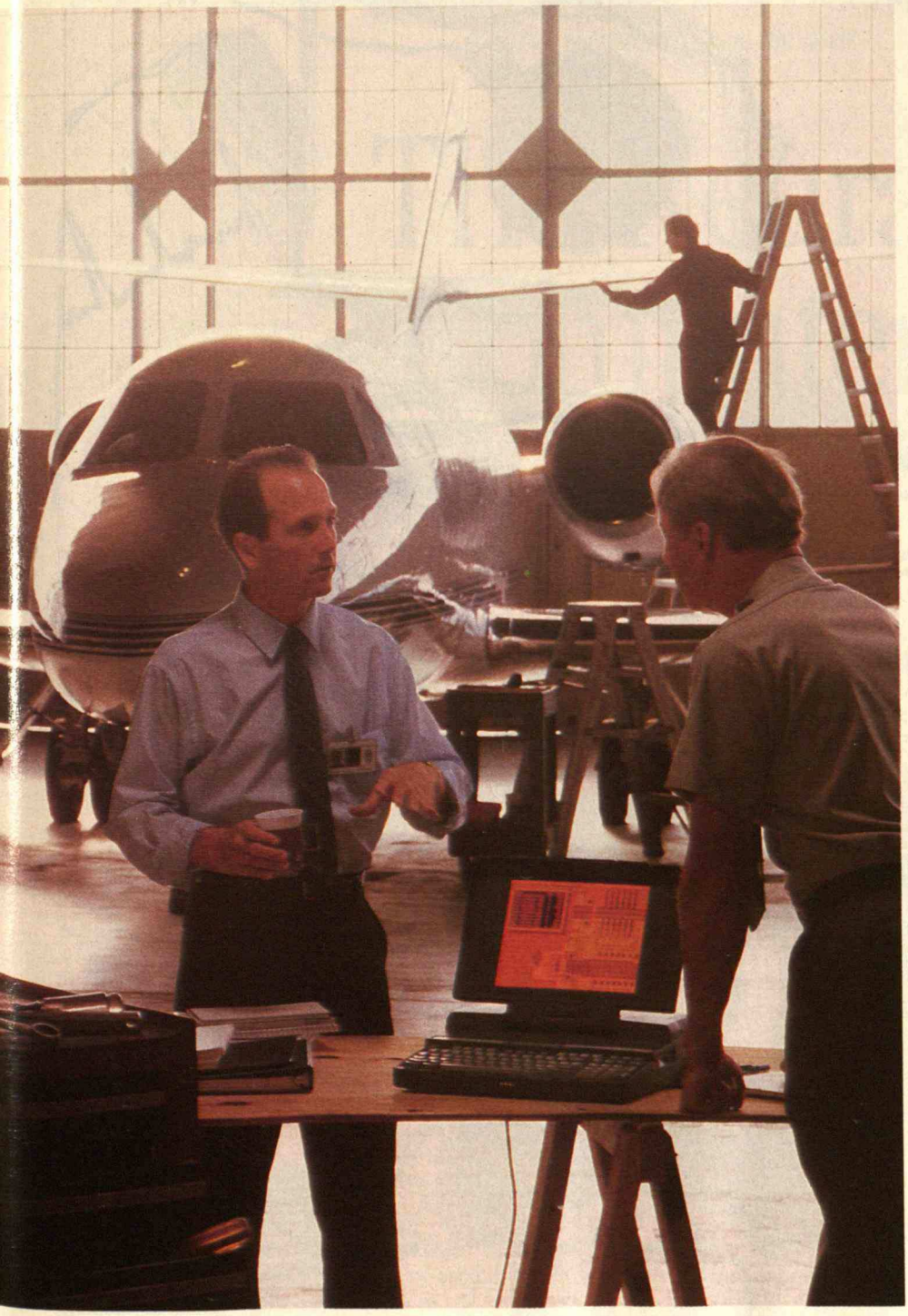

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In Touch with Tomorrow

TOSHIBA

Toshiba America Information Systems, Inc., Computer Systems Division

By Herb Brody

No computer can match the brain. But neural networks are tackling jobs at which the brain leaves ordinary computers in the dust.

The Neural Computer

CHANGES are coming to chili farming in Hatch, N.Mex. Bill Gary grows chilies on 200 acres in this town situated between El Paso and Albuquerque. Each year, he spends $300,000 to $500,000 on labor to handpick the long green peppers. But Gary has dreamed up a way to save money and enter the twenty-first century to boot. Armed with a neural network vision computer he developed with his cousin, software engineer Craig Davidson, robots should be able to pick out the chilies from the leaves in which they lie camouflaged. Although the vision system works already, Gary is still looking for a suitably rugged, inexpensive, and dexterous robot that will make automated chili-picking a reality.

After a spate of overoptimistic publicity several years ago, neural networks are entering practical use. They have not replaced conventional computers. Despite an ability to "learn" from experience, they have not accelerated the evolution of robots into androids like C3PO in *Star Wars*. And they bear only the most superficial resemblance to the workings of an animal's brain. But researchers and industry are grooming this new breed of computer for a diversity of assignments that conventional computers handle poorly or not at all.

Many of these tasks involve making sense of patterns. The roster of possible jobs for neural networks includes deciphering handscrawled zip codes, converting spoken words into computer in-

ILLUSTRATION: GEOFFREY MOSS

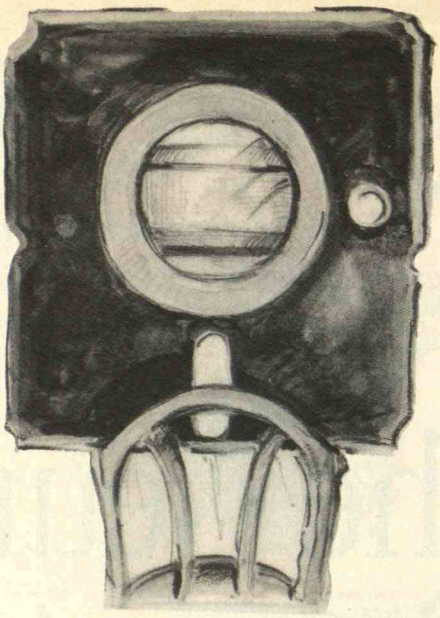
put, and evaluating loan applications. And farmer Gary is trying to adapt neural networks for other crops that require visual assessment before picking, such as grapes, coffee beans, and onions.

How They Work

A neural network is not an electronically jury-rigged replica of an animal's nervous system. Specialists in brain research scoff at the suggestion that an artificial neural network has anything at all to do with a brain, other than the contrivance of a common terminology. Virtually all neural networks in use today don't even use specialized hardware; they consist of software that runs on a conventional computer, sometimes even a PC. The notion that neural networks mimic the brain is "nonsense," says Caltech neurobiologist Jim Bower.

Still, architects of neural network computers draw their inspiration from the biological model. The brain gets its power not from the speed of its individual switches but from the way they are linked together. Individual neurons fire only a few times per second, millions of times slower than the transistors in a personal computer. It is the complex interconnection of these neurons that gives the brain the crucial ability to recognize patterns—and hence to learn.

As in the brain, an artificial neural network is constructed of simple components. Each electronic "neuron" has a straightforward assignment. Typically, it takes many input values, adds them together, and performs a mathematical operation on the sum to give a single output. Many of these electronic neurons perform their operations at the same time; this parallelism resembles the way the brain works and differs from the serial processing of a conventional computer. In another similarity to the brain, the network's function is determined by its topology—the way in which the neurons are interconnected. This also distinguishes neural networks from conventional computers, which rely primarily on a coded set of instructions, or program.



A neural network gets its pattern recognition power not from the speed of individual switches but from the way in which they are interconnected.

Neural networks differ fundamentally from the more popular "expert system" approach to building an intelligent machine. An expert system contains the codified knowledge of human experts in a particular field. This knowledge generally takes the form of if-then rules. A medical diagnostic computer, for example, might have a rule such as: *"if* the patient has high fever, headache, and stiff neck, *then* treat immediately for meningitis."

The problem with expert systems comes in systematically laying out the rules. People don't always know exactly why they do what they do. And even when they can express this knowledge, it is not easily translated into usable computer code.

Neural networks, by contrast, do not require an explicit set of rules. The network—rather like a child—makes up its own rules that match the data it receives to the result it's told is correct. Handwriting recognition offers a good example. To train the network, you show it thousands of handwritten letters in a variety of orientations and tell the computer what letter each sample is supposed to be.

A neural network computer trained in this way will learn to recognize the letter *a* in a variety of handwriting styles—including styles not represented in the training data. The U.S. Postal Service takes the technology seriously: it is funding research at Bell Labs to develop a neural network system to read handwritten zip codes, expediting mail delivery. (Machines already scan envelopes for the zip code but reject most handwritten ones as illegible.)

Within the artificial intelligence community, neural networks and expert systems sit on opposite sides of an almost ideological barrier. Proponents of expert systems argue that the critical step in solving a problem

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HERB BRODY is a senior editor of Technology Review.

is gathering and organizing the knowledge. Advanced speech recognition systems, for example, contain a set of linguistic rules that provide hints on what words are likely to follow other words. If the system recognizes the word "very," it can narrow its search on the next word to adjectives and adverbs.

A neural network, on the other hand, attempts to solve the problem with only the information that it gleans from repeated exposure to speech; in a sense, it develops intuition about a problem rather than memorizing facts. This intrinsic flexibility enables a neural network to adjust on its own to changes in its environment.

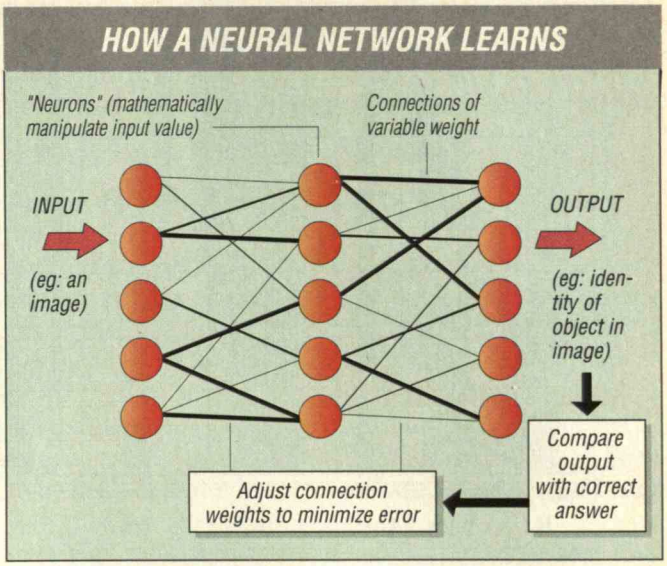
Weighty Decisions

Unlike most computers, a neural network learns from its mistakes. Computer scientists have devised many mathematical processes, or algorithms, to allow neural networks to adapt. These algorithms differ in details, but most follow the same general principle.

Each neuron takes many input values, multiplies each by a "weighting" factor, adds together the products of these multiplications, and mathematically operates on this sum to produce another set of values. These numbers may translate directly into an answer—say, the identity of a spoken word or a written character. More complex systems channel the outputs from one set of neurons to many other neurons, again through weighted interconnects.

The network adapts and learns by varying the connection weights. A speech recognition computer, for example, first divides the voice signal into many short intervals of time. For each interval, it measures the relative amount of energy in different frequency bands. The range 100 to 200 hertz (cycles per second) may get a value of 0.5, while a stronger signal in the range of 2 to 3 kilohertz (thousand hertz) might have a value of 0.7. The neural network multiplies each of these numbers by a weighting factor and performs a mathematical operation on the sum. The speech computer compares the resulting pattern with that produced by other sounds, words, and phrases it has learned.

The neural network begins with weights set randomly. Then, during training, it adjusts its weighting factors to align its responses with the desired ones. The computer first looks at the magnitude of error to see how much it needs to adjust. Suppose the word "yes" was spoken. If the system concludes that the probability of the word being "yes" was 80 percent, its error is 0.2. If it declares a probability of 10 percent, its error is 0.9.



A neural network learns from experience. Each neuron multiplies a set of input values by a connection "weight," adds the products of these multiplications, and performs a mathematical operation on the sum. The resulting number is typically fed into another layer or two of neurons, which operate in a similar fashion and produce an output. Initially, the weighting factors are set randomly; during training, the network adjusts these weights so that its answers correspond with reality.

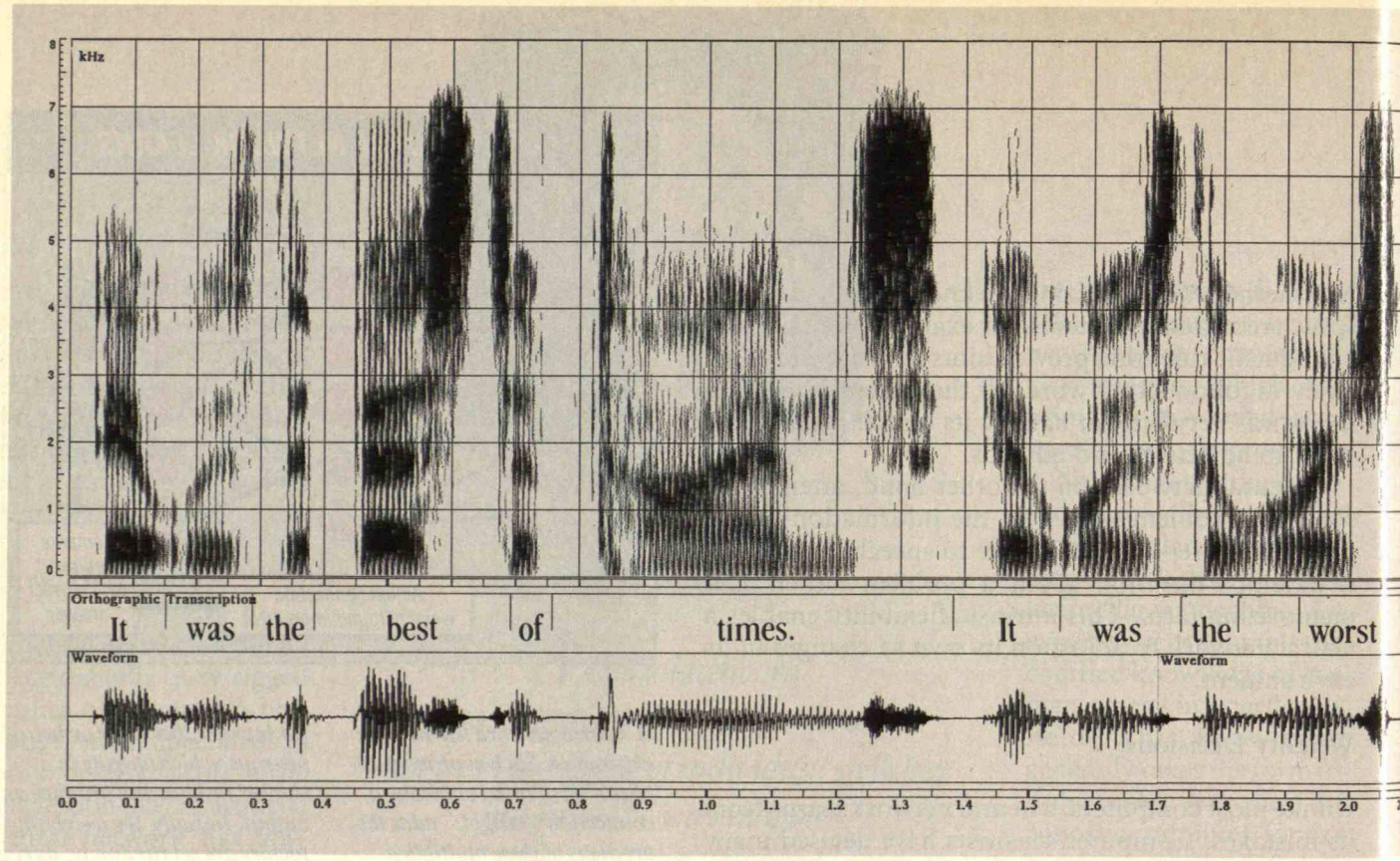
The system cannot know which weights caused the error. So it systematically increases or decreases the weights by a small amount in a direction that it estimates will make an error less likely. If the change reduces the error, then the network adjusts the weights some more in this same direction. It continues to do so as long as each change produces a smaller error. When the error begins to rise, the weights are left alone.

Different neural networks compute the error in different ways. Some compare the system's final answer with the true answer. Others adjust themselves one level deeper. They compare the value of the weighted sum—before it passes through the mathematical operation—with the sum produced by the sample pattern. This approach allows more precise tuning of weights but requires more computational power.

Neural Nets at Work

Most of the funding to study neural networks has come from the military. A smart, adaptable vision computer

DIAGRAM: DEBORAH PERUGI DESIGN



could be a boon to image-guided weaponry because it would be relatively easy to reprogram. A neural computer might also aid in verifying nuclear arms treaties. By analyzing seismographic signals, a neural network could tell whether a rumble in the earth more likely emanated from an earthquake or from an underground nuclear explosion. Similarly, a neural network could check sonar echoes and swiftly determine whether they revealed an enemy submarine.

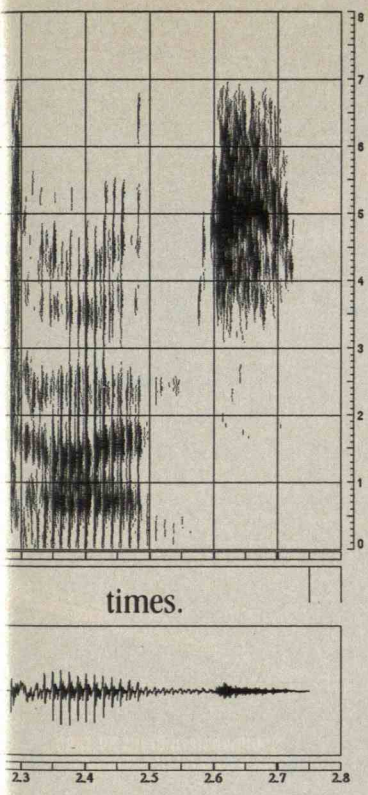
A few years ago, these prospects seemed compelling; a report sponsored by the Defense Advanced Research Projects Agency recommended a four-year, $100 million per year program in neural nets. DARPA's present effort is far less ambitious; the agency plans to spend $33 million over the next two and a half years. The agency is exploring whether neural networks warrant a larger investment, according to program manager Barbara Yoon.

While DARPA is proceeding cautiously, industry is seizing on the technology to attack a variety of problems that stymie conventional computers. Airplane luggage in New York, Miami, and London goes through an unusually rigorous inspection before being loaded into the cargo bay. In addition to x-raying the bags for metal weapons, these airports use neural networks to screen for plastic explosives. The detection system bombards the luggage with neutrons and monitors the gamma rays that come flying out in response. The neural network analyzes the signal and decides whether it came from an explosive.

That's a difficult distinction to make. Different chemical elements release different frequencies of gamma rays. Explosive materials are rich in nitrogen, so an abundance of gamma rays at nitrogen's frequency raises suspicion. But some benign substances—including protein-rich materials such as wool and leather—also contain a lot of nitrogen.

To be practical, this system should detect explosives with 95 percent probability while raising as few false alarms as possible. In a non-neural prototytpe version, developer Science Applications International of San Jose interpreted the data with a standard statistical technique called discriminant analysis. This version took days to calibrate. It also produced an unacceptably high number of false alarms. With its sensitivity set for a 95 percent probability of detecting a bomb, it had a 4 percent probability of incorrectly flagging a harmless suitcase.

Then Science Applications tried a neural network. The company fed the network a batch of instrument readings, along with information on whether explosives were indeed present—and then walked away. After a weekend of essentially untended operation, the computer had taught itself how to discriminate an explosive from a benign material. At the 95 percent detection point, it raises false alarms on only 2 percent of the harmless pieces of luggage. The system can handle 600 to 700 bags per hour, so this reduction in false alarms translates into dozens fewer bags that the airport must open and examine each day.



To be recognized by a machine, spoken words (waveform, bottom) are broken into their component frequencies (spectrogram, top). Most of today's speech computers require pauses between words. Neural networks' superior pattern-matching abilities should let them work with normal, connected speech—a far more difficult and more useful task.

Neural networks have sparked serious interest from the financial community as well. This may at first seems puzzling. After all, neural networks do not provide the kind of exact answers that would seem to be central to financial transactions. But finance is really a game of guesses. Correct guesses will, over the long term, reap profits.

In one of the first commercial uses of neural networks, banks can now use the technology to evaluate mortgage-loan risks. Nestor Inc. of Providence, R.I., says its neural network risk analyzer is more consistent than human underwriters in evaluating applications.

The Nestor system examines 50 to 80 pieces of data on the applicant's income, assets, number of dependents, and credit history, as well as the location and value of the property. To train the system, Nestor fed it mortgage applications from previous years, along with information on whether the loan was approved or denied.

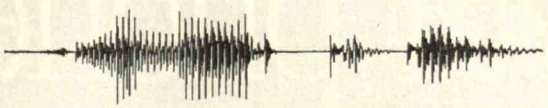
Over time, as it processes more applications and tracks the outcome of the loan, the network will refine its model. It will adapt internally as market conditions change. In this the system differs fundamentally from an expert system, which relies on a static set of rules. Nestor declines to identify the one mortgage underwriting firm it says is using the risk analyzer.

American Express and Chase Manhattan Bank have also developed neural networks to help them spot patterns in financial data. The Chase system is designed to cut the enormous cost of stolen credit cards. Chase programmed the system with reams of data on credit-card transactions, indicating which ones turned out to be fraudulent. The neural network sorted through the information and identified trends. It found, for example, that the transactions most likely to be questionable involved the purchase of women's shoes for $40 to $80.

Neural Futures

Virtually all of today's neural networks exist as software that runs on an ordinary computer. This is appropriate as long as neural networks are in a developmental stage; it's much easier to change a program than to rewire a circuit. But if neural networks are to fulfill their potential, new hardware will be needed. To make neural computers practical, they will need to be fast—and it is axiomatic that things happen faster in hardware than in software.

In the last year, neural networks have been crystallized into integrated circuits at Bell Labs, Caltech, and elsewhere. These are analog chips. They store information as a continuous range of values, typically as voltages on a capacitor rather than as the binary *1*s and *0*s signified by a transistor's on-off switches. Since the inputs to a neural network are often analog values—the brightness of a pixel, say, or the strength of a sound



In one of their first practical uses, neural networks are helping several airports detect plastic explosives in airplane luggage. A system developed by Science Applications International bombards each bag with neutrons and monitors the gamma rays emitted as a result. The neural network looks for gamma-ray frequency distributions that indicate high concentrations of nitrogen, which bombs contain in abundance.

PHOTO: SCIENCE APPLICATIONS INTERNATIONAL

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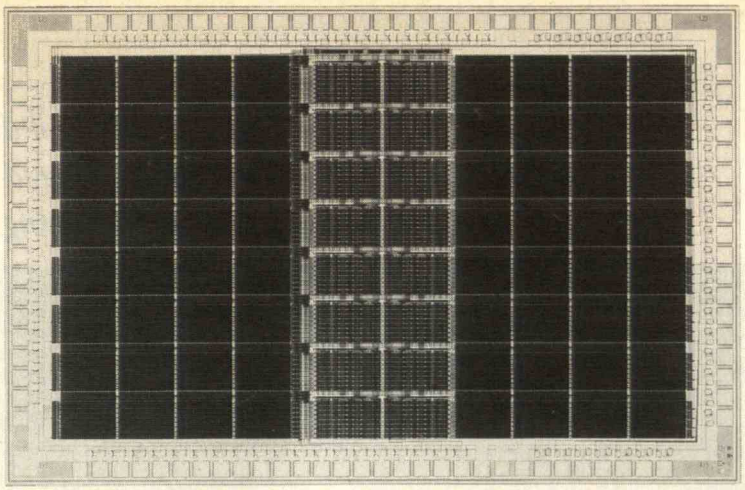


Although most neural networks exist as software simulations that run on conventional computers, neural-network integrated circuits can work much faster. This chip from Neural Semiconductor can perform more than 300 billion connections per second.

signal—analog chips offer a fast, albeit less precise, computing shortcut. Neural network integrated-circuit chips are now available commercially from Intel, which makes the microprocessors used in most IBM-compatible personal computers, and from Neural Semiconductor of Carlsbad, Calif.

By encoding weights as voltages on a chip, neural networks can operate much faster than when they rely on software in a conventional computer. Engineers measure the speed of these chips in terms of "connections" per second. One connection is defined as a multiplication operation followed by an addition—corresponding to the multiplication by a weight factor and the addition of the product to a sum. Bell Labs' latest chip is capable of 100 billion connections per second—about 10,000 times faster than is possible using conventional hardware.

Although encouraged by the advent of neural-network chips, experts expect computer users to see incremental improvements, not orders-of-magnitude leaps in performance. Still, there are some dramatic—and surprising—possibilities. One experimental neural network program developed at Stanford sits in the driver's seat of a computer-simulated tractor-trailer truck, which it attempts to back up to a loading platform. With the neural network at the wheel, the truck lands in perfect perpendicularity. The network truck accomplishes this feat (a challenge to all but the most practiced human drivers) regardless of the truck's initial position; it can even be jacknifed. The network taught itself this delicate skill after thousands of tries, according to Stanford's Bernard Woodrow.

This truck-backer-upper is a whimsical demonstration, but the idea of using neural networks to control movement has practical potential. Science Applications, for example, is developing a neural network to quell vibration in industrial equipment. Sensors would monitor the vibration of an apparatus such as a motor. The neural network would learn from experience to recognize patterns in the vibration and so could predict the motor's behavior from millisecond to millisecond. The neural network then could direct a system that applied opposing mechanical forces to cancel out the vibration, prolonging the equipment's lifespan.

An item on everybody's technology wish list is speech recognition. Today's speech systems are "speaker dependent"; they work only when trained to the peculiarities of a person's voice. Moreover, they recognize only words that are surrounded by silences. They cannot handle normal speech, in which one word slides into the next in rapid succession.

Neural networks could break through this barrier. Many labs are working on this problem, including MIT's Lincoln Lab, Bell Laboratories, and Carnegie-Mellon University. Such a system might break a several-second segment of sound into many smaller chunks and store them in memory. The neural network then could swiftly and simultaneously check each of these chunks to see if it matched a known word or phoneme. It would be like playing 21 questions—but asking all the questions at once, instead of in sequence.

Another promising area is telecommunications. Some telecommunications networks break signals into "packets" that travel to the same destination via different paths. With its gift for recognizing patterns, a neural network could select the path that each packet should take through the network. The decision would minimize the transmission time and avoid snarling the network. Neural networks are ideal for such problems, which involve satisfying many constraints simultaneously.

Neural networks will achieve their ultimate power working in concert with other computer technologies. For example, a robot might use neural networks to help it see, hear, move, or even smell, then rely on an expert system to make complex decisions based on this data.

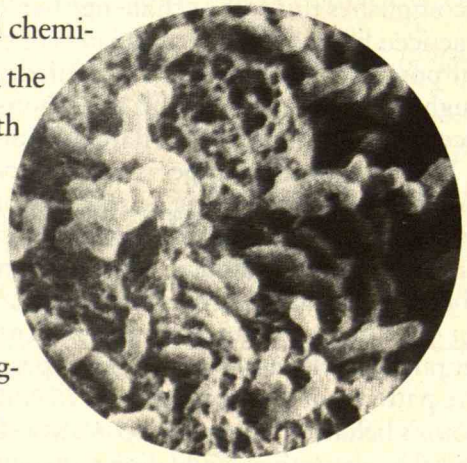
Biologists insist that the brain defies our understanding and thus our imitation of it. They are right. One hundred years ago, experts said people would never fly like birds. They were right, too. But in a staggering leap of imagination, people figured out how to fly in an entirely different way, without hollow bones, feathers, or flapping wings. Today's neural networks hint at the possibilities. ■

Biology is renewing the U.S. copper industry while protecting the environment. It could do the same in other fields of metal mining.

Mining with Microbes

By Keith H. Debus

ARCHEOLOGICAL evidence unearthed at Timna, Israel, indicates that the mining and smelting of metal ores have been carried out in Western civilization since at least 4500 B.C. This discovery has dramatically altered archeologists' conception of how early humans obtained metal for making tools and ornaments. Ancient people were believed to have found metallic rocks and simply hammered them into shape. Instead, we now know that these early civilizations identified ore bodies where metal was combined chemically with other elements, dug the ores from the earth, and processed or "smelted" them with fire to extract valuable metal from otherwise worthless rock.



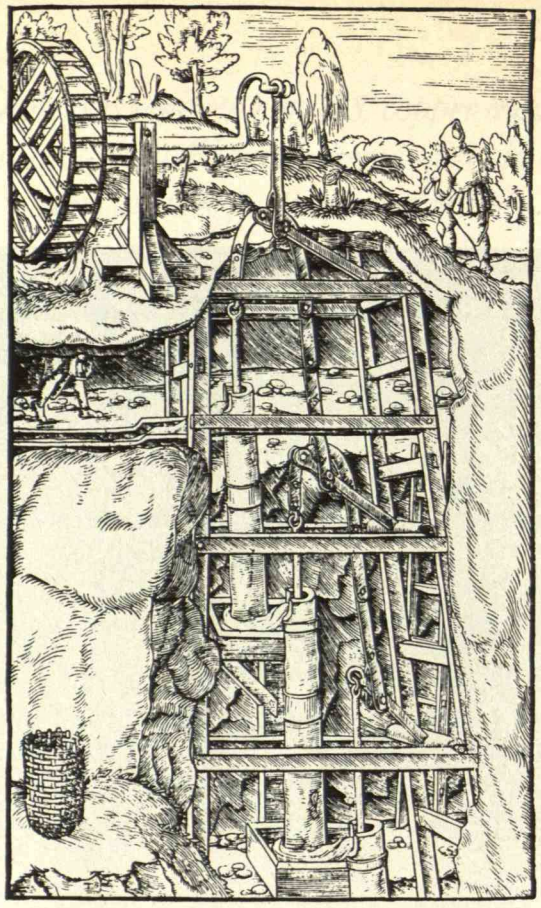
Timna is often cited as an example of how technologically advanced early civilizations were. Conversely, these findings sig-

Today's open-pit mining leaves ore and waste that leach acid and metals into ground and surface waters. Above: The former Anaconda mining operation in Butte, Mont. Left: The industry is using the naturally occurring bacterium Thiobacillus ferrooxidans *to extract metal at old mining sites. Someday miners may inject microbes into underground ore deposits and mine metal without digging pits.*

PHOTOS: COURTESY OF KEITH H. DEBUS; DR. DAVID HOLMES

nify how primitive our own minerals industry is, since basic mining techniques have changed little in the intervening 6,500 years. The global mining industry still largely digs rocks from the ground and smelts them to obtain the valuable metals.

This simple technique has served Western civilization extraordinarily well, given three conditions: high-grade ore, inexpensive energy, and dormant concerns for environmental degradation. But as the mining industry enters the 1990s, none of these conditions is likely to prevail. As a result, scientists and engineers are moving with some haste to apply biotechnology to mine low-grade metal-bearing ores. This approach requires little energy consumption and entails minimal environmental disturbance.



Basic mining techniques—digging ore and smelting it to separate the metal—have hardly changed for six millennia. A 1556 illustration from De re Metallica *by Agricola shows a medieval mining operation. Suction pumps driven by a water wheel removed the water that collected in the bottom of a mine.*

Seeds of Change

Early civilizations mined and smelted ores containing a high proportion of metal. As centuries and millennia passed, miners steadily exhausted higher-grade ores, and the industry needed to learn to mine lower grades economically. By and large, though, the ancient techniques remained unchanged. The industry simply increased the size of its activities to capture economies of scale. These efforts to reduce production costs per pound of metal led to the open-pit mining that predominates today.

Unfortunately, the expansion of metal mining has been paralleled by environmental degradation. Modern open pits are measured in square miles—some are as large as a medium-sized city—and they generate millions, or billions, of tons of wastes. Setting aside aesthetic debasement, such enormous pits contaminate water. As groundwater and precipitation percolate through pits and ores open to the atmosphere, they become contaminated with acid and metals. The same thing takes place in hundreds of square miles of waste dumps. Some of this degradation will continue for centuries or even millennia: Roman lead-zinc mines in Wales are still a source of contamination nearly 2,000 years since they were first used.

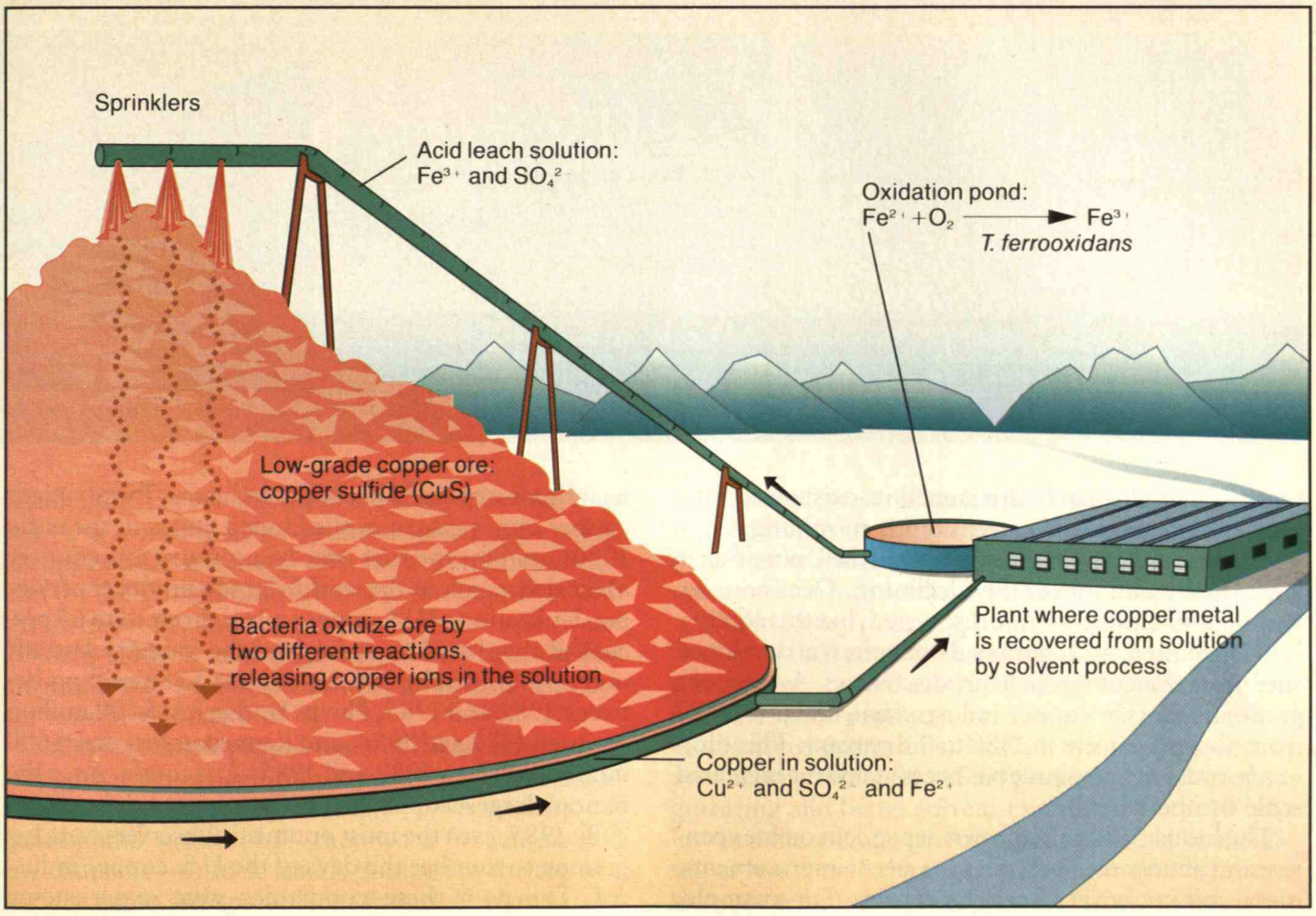
Moreover, huge smelters that separate sulfur from metal expel gases and particulates laden with metals and sulfur dioxide, the precursor of acid rain. For example, the copper industry produces two tons of sulfur gases for every ton of metal.

The metal-mining industry has arrived at a juncture where its quantitative expansion is bringing about a qualitative change in its techniques. In an industry that handles billions of tons per year and barely blinks at the challenge of moving a mountain, organisms too small to see with the human eye are the foundation of this transformation. Some industry observers credit biological techniques with saving the U.S. copper-mining industry in the last decade. Visionary enthusiasts describe the mining of the future as a biotechnology-materials industry.

In contrast to the fanfare accompanying biotechnology in pharmaceuticals and agriculture, this approach has been making quiet inroads into metal mining and processing. Even so, by 1989, over 30 percent of the copper produced in the United States resulted from a biochemical process catalyzed by a ubiquitous microorganism called *Thiobacillus ferrooxidans*.

Biohydrometallurgy, the term scientists have adopted to describe this merger of biology and metals, has not been limited to copper. The first commercial use of biotechnology to leach uranium from abandoned mine works occurred in Canada in the 1970s. And the mining industry is most excited about the biological

KEITH DEBUS teaches mineral economics at Montana College of Mineral Science and Technology in Butte and is a technology economist at the Center for Interfacial Microbial Engineering at Montana State University. He has served as a consultant to numerous companies on biohydrometallurgy and other matters.



preparation of certain gold ores that resist processing by standard methods. Two such commercial plants have operated in South Africa since the mid-1980s, and in Nevada this year, U.S. Gold will complete North America's first commercial-scale plant employing these microbiological techniques.

Biohydrometallurgy will help reduce acid rain. Intensive research at ARCTECH in Alexandria, Va., and the Idaho National Engineering Laboratory, as well as elsewhere in the United States and abroad, seeks to use microorganisms to efficiently and inexpensively remove sulfur from coal before power plants burn it. This would sharply reduce sulfur-dioxide emissions and acid rain. For the future, using these microorganisms is likely to yield super-clean coal. The process may enable the industrialized world to continue exploiting its most abundant fossil fuel without sulfur-dioxide emissions.

Several commercial applications already use the metal trapping and concentrating capabilities of some bacteria, algae, and fungi to remove and recycle metals from industrial wastewater, and significant research continues in this area. In South Dakota, Homestake Mining began to use a biological system to break down the cyanide in its waste in 1983. That system's performance has exceeded expectations and environmental mandates from the state.

Copper is mined with an acid leach solution that contains water, Thiobacillus ferrooxidans, *Fe^{3+} (ferric ions), and SO_4^{2-} (sulfate ions, which form sulfuric acid in water). The solution is sprinkled on low-grade ore consisting of copper compounds such as CuS (copper sulfide).* T. ferrooxidans *catalyzes two chemical reactions, yielding Cu^{2+} (cupric ions), Fe^{2+} (ferrous ions), and sulfate.*

Next, a solvent process in a plant removes the copper, and the remaining solution goes to an open pond. In the presence of oxygen from the air, T. ferrooxidans *catalyzes a reaction in which an electron is removed from Fe^{2+} ions to produce Fe^{3+} ions. The solution with Fe^{3+} ions and sulfate is finally pumped back onto the ore pile.*

Among the most promising applications of biohydrometallurgy is in culturing and growing bacteria to reverse the process that creates sulfuric acid and releases metals into water. Boojum Research Ltd. of Toronto has developed such "sulfate-reducing" systems at two Canadian mines that remineralize the sulfur and metals before water leaves the mine area. This "ecological engineering" of mine wastes may hold a key to twenty-first-century mining.

The Case of Copper

Developments in the U.S. copper industry, as it overcame problems that recently hindered its competi-

DIAGRAM: DEBORAH PERUGI DESIGN

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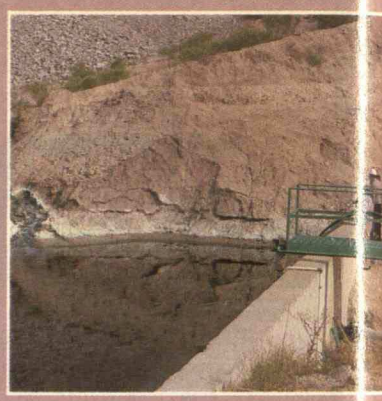

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tiveness and ultimately threatened its existence, illustrate the potential of biotechnology in mining.

The grade of copper ore available in the United States is gradually and inexorably declining. Occasionally, new high-grade deposits are discovered, but this country is well explored, and continued operations at developed sites more than offset such rare discoveries. Average ore grade in the U.S. copper industry has fallen steadily from above 6 percent in 1880 to 0.6 percent. This drop of one order of magnitude has necessitated the increased scale of operations.

The industry has also grown dependent on inexpensive and abundant energy. Despite recent improvements, metal mining is very energy intensive. For example, producing one ton of copper in the United States by conventional means requires over 5 tons of coal. Furthermore, about half this energy moves and crushes rock that averages 99.4 percent waste.

The public has grown increasingly concerned about metal mining's record of environmental disturbance. For every pound of copper produced by conventional means in the United States, the industry produces 198 pounds of waste. The U.S. copper industry alone produces hundreds of millions of tons of waste each year. It now depends on moving entire mountains or creating tremendous craters in the earth to obtain the necessary metals. These open pits cause contamination problems, since the ore and waste tend to leach acid and heavy metals such as arsenic into both ground and surface waters.

Furthermore, processing ores results in air pollution as smelters emit sulfur dioxide and other compounds. This problem and stricter standards issued by the U.S. Environmental Protection Agency led the industry to spend billions of dollars to contain sulfur emissions in the 1970s, and several large smelters that could not make the changes profitably were forced to close. Then came the global recession of 1981 to 1982 and worldwide overproduction, which sent copper prices plunging from a high of $1.45 per pound in 1980 to just $.58 per pound in 1985.

The convergence of these factors culminated in the near demise of the U.S. copper industry. Twenty-eight copper mines closed in the United States in the early 1980s, and for the first time in a century this country abdicated its role as the world's largest producer of copper. Utilization of U.S. copper mines dropped to 65 percent of their total capacity, and the industry laid off over 35,000 employees. Asarco lost $384 million between 1982 and 1985, Phelps Dodge lost $400 million between 1982 and 1984, and Kennecott lost over $600 million between 1982 and 1985. Anaconda, once the nation's largest copper producer, went out of business.

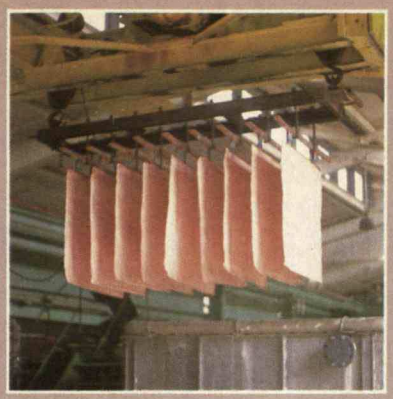
By 1985, even the most optimistic observers were beginning to number the days of the U.S. copper industry. The pain these companies were experiencing emphasized that their anachronistic means of production had to change dramatically. The industry's very survival compelled a technological breakthrough. That breakthrough is coming from a well-known but little-understood process carried out with modern tools.

A Technique from the Past

The first documented commercial use of "bioleaching" to mine ore occurred two centuries ago at the famous Rio Tinto mine in Spain, which had been a major source of copper for the Roman Empire.

Over thousands of years of mining, waste rock had piled up for several miles around this site. In 1752, a mining engineer noticed that the bluish-green water running out of and over these dumps coated pieces of scrap iron with the familiar reddish-brown hue of copper. The film, which could easily be removed with a fingernail, turned out to be 80 to 90 percent copper. Thus began the long, circuitous route to using microorganisms in recovering and processing metals.

The copper precipitate on the scrap iron at Rio Tinto has come to be known as "cement" copper. As melting snows and rain percolate through mining waste, they provide *Thiobacillus ferrooxidans* with water for their metabolic processes. These bacteria catalyze the oxidation of sulfide minerals—that is, they promote a chemical reaction in which the sulfur (S) from copper



Modern copper leaching operations. 1) Terraces built at the Miami Mine in Miami, Ariz., allow miners to distribute leaching solution containing Thiobacillus ferrooxidans *to old ore. 2) At the Bluebird Mine in Miami, Ariz., the solution is sprinkled on top of a leaching pile. 3) The pond of solution after percolating through ore is blue from dissolved copper. 4) A solvent-extraction process removes impurities. 5) Then electricity is passed through the solution to produce sheet copper at the cathodes (positive terminals).*

sulfide (CuS) in the unmined ore combines with oxygen (O_2) from the air to produce sulfate (SO_4). The bacteria utilize the energy that is released in the reaction for their metabolic processes. The copper (Cu) is left as free ions, and the sulfate combines with water to form sulfuric acid (H_2SO_4). When the solution pregnant with copper encounters scrap iron, the copper ions precipitate out.

Today this simple process remains largely unchanged, except that the copper industry is more purposeful in its practice. Since *Thiobacillus ferrooxidans* are "acidophilic autotrophs"—they work best in an acid environment—sulfuric acid is pumped to the top of a heap or dump and sprayed over the ore. Solvent extraction, a more efficient and less expensive process, has now largely replaced scrap iron for removing copper ions from the solution.

The first commercial application of bioleaching took place in North America in 1907 at a since-abandoned copper mine in British Columbia. By the next decade, nearly all large U.S. copper mines were rapidly adopting the technique at otherwise useless dumps, even though the industry had little or no understanding of it. Miners simply knew that if water was poured over dumps, the solution that issued from the bottom was laden with copper. They found that when sulfur was added to the water, creating sulfuric acid, copper production was enhanced.

It remained for microbiologists A. R. Colmer and M. E. Hinkle in 1947 to identify the organism responsible for bioleaching. Initially, their work sought to explain acid mine drainage, which results from water percolating through inactive mines and running out acidic and laden with metals. They discovered that such drainage occurs because *Thiobacillus ferrooxidans* oxidizes iron sulfide (pyrite). By 1958, microbiologist L.C. Bryner and his colleagues had found that the same organism can oxidize copper-sulfide minerals. This early work was followed by research on other metallic ores, and biological leaching has often proved feasible.

Nevertheless, although the bioleaching of copper ores grew in the postwar era, it did so very slowly. Mining companies treated their leach operations like an unwanted stepchild. The technique contributed billions of dollars to the corporate bottom line, but companies returned little into further R&D on biological methods.

The industry's near liquidation led to a determination to reduce costs to a minimum. Conventional efforts to lower capital costs and energy consumption and increase labor productivity, along with expansion of bioleaching operations, had cut the average cost of production from $.90 to $.60 per pound. Improved engineering and better solvent-extraction methods have lowered the average cost of copper mined by bioleaching to less than $.30 per pound. Some mining operations are reported to go as low as $.25 per pound, while because of increased worldwide demand for it, copper now sells for over $1.00 per pound. Simultaneously, environmental impacts have been reduced, since bioleached ore need not be smelted. Phelps Dodge, the nation's largest copper producer and among the most aggressive users of bioleaching techniques, expects to produce over half its copper by bioleaching by 1993 at less than $.30 per pound.

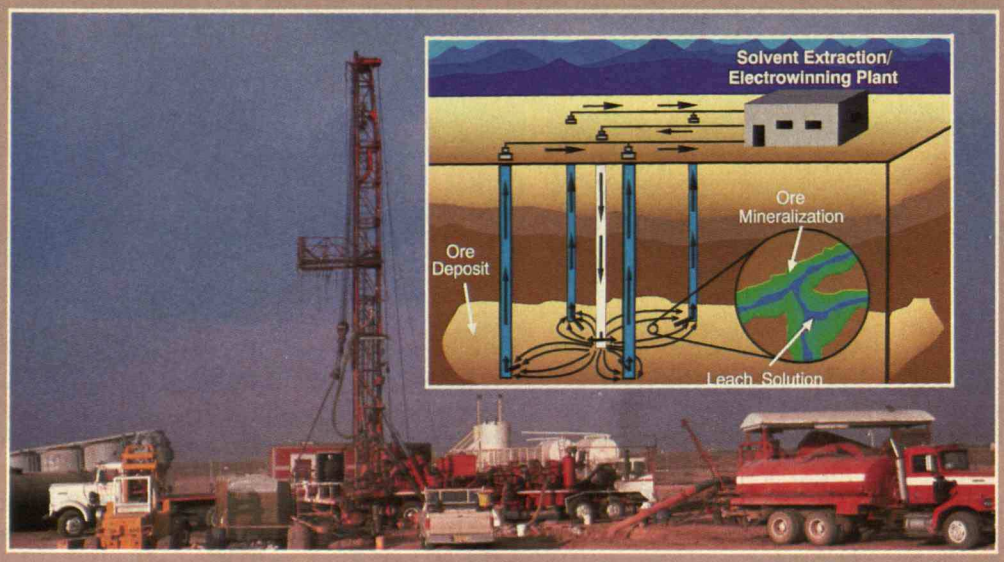
Future Proposals

Among the most exciting prospects for the emerging applications of microorganisms is in-situ mining, which would leave the surrounding environment relatively undisturbed while removing the desired metals.

Conventional mining requires moving phenomenal amounts of rock to obtain a relatively small amount of metal. When an ore body is identified, these techniques sacrifice the overburden—trees, plants, topsoil, and other requisites of a healthy natural environment. Then vast amounts of rock are processed.

With biotechnology, once an ore body has been identified and deemed economic to develop, wells would be drilled into it and the ore fractured. Then the ore body would be inoculated with either a naturally occurring bacteria such as *Thiobacillus ferrooxidans* or one engineered for extracting a specific metal, and the ore would be flooded with water. This water would be

PHOTOS: U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES



In in-situ mining, a leach solution with Thiobacillus ferrooxidans *or other microbes is pumped into an ore deposit that has been fractured. The solution is then piped to a plant that extracts the metal. Environmental damage is practically nil. Inset: In-situ mining at the Santa Cruz site in Arizona.*

collected and pumped to the surface pregnant with the desired metals. The top of the mine would show little environmental or aesthetic damage, and inside the earth, the ore deposit would remain intact minus a small fraction of valuable metal. The only lasting impact on the site would be several capped holes.

Companies like Boojum, which already biologically treat mine water coming out of abandoned sites, point to a future of "ecological engineering." Large-scale ecological engineering might use artificial swamps to transform today's active and inactive mines into the mine sites of the twenty-first century. Such swamps would concentrate metals through several processes. Microorganisms would recombine the sulfuric acid and metals that occur naturally in flooded mine sites to form sulfide ores. Metals would be adsorbed onto the surface of fungi, algae, and higher plants, and would be absorbed into plants. As these organisms die and decay, the concentration of metals in the swamps would rise.

After many years, the sediment at the bottom of the swamp would contain enough metal to exceed the economic threshold for viable biological mining. The swamp could then be biologically leached by *Thiobacillus ferrooxidans* or another oxidizing microorganism that would separate the metal in the form of ions.

As a final processing step, a supersensitive "biosorption filter" would probably replace solvent extraction and complete an entire cycle of metal production biologically. Constructed of dead microorganisms with an extraordinary ability to remove metal from a pregnant leached solution, several such filters have already been applied commercially, principally to clean industrial wastewater. Thus, metal production would become entirely biological, with little active human participation and minimal energy input.

Despite biohydrometallurgy's advantages, several technical problems limit its commercial feasibility. First, the methods are slow. Conventional processes can recover most metal from an ore body in a matter of months or years, depending on the size of the deposit and the level of resources applied to production. But biological metal recovery may take decades. Where both techniques have been evaluated, biological approaches have often been found to be cheaper, but a delayed cash flow from slower production has hindered their adoption. Consequently, biohydrometallurgical processes have been considered economically feasible only with low-grade ore, when conventional techniques are inappropriate.

Another major impediment to biological mining has been the lack of effective ways to break ores into small particles. Increasing the surface area in this way multiplies the number of interactions between microorganisms and minerals, improving the metal-recovery rates. The mining industry uses a variety of methods to produce particles, but the primary one remains explosives, followed by crushing and grinding. These crude and blunt techniques, which haven't changed much since the early rock fracturing and hammering of the ancient miners, are inadequate to gain full use of in-situ techniques, particularly in previously unmined bodies. For biological metal extraction to achieve its full potential, miners need a practical way to inexpensively permeate large ore bodies in situ with innumerable tiny fractures.

Serving Conflicting Goals

In President Bush's 1988 campaign, he vowed to seek means to reduce waste production and encourage recycling. He has gone so far as to propose a tax on virgin materials to help pursue both goals.

Metal mining is a prime example of private self-

PHOTO/DIAGRAM: U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES

Cattails developed by Boojum Research of Toronto are transplanted to areas where toxic effluents leave abandoned mines. The plants promote a microorganism that reduces the acidity of mine drainage. Other microorganisms naturally associated with cattails catalyze a reaction recombining dissolved metals and acidic sulfate to form innocuous compounds.

The microbial process is safer and cheaper than the standard procedure of dumping limestone in effluents to reduce acidity. Though limestone does cause metals to precipitate out, they do not form a new compound and may eventually leach into groundwater.

interest leading an industry toward these ends. But the metal mining industry continues to create billions of tons of waste, spew tons of sulfur into the atmosphere, and acidify the nation's water and contaminate it with metals. Even now, the industry spends less than 2 percent of sales on R&D—compared with 3.5 percent for U.S. industry overall—and almost nothing on biological processes. (Newmont Mining has proved to be among the most farsighted. It recently established a biological metallurgy lab led by James Brierley, a venerable microbiologist who first isolated and cultured an organism that oxidizes sulfide minerals at very high temperatures.)

Moreover, the mining industry did not adopt biotechnology in a totally free market. The environmental regulations of the 1960s and 1970s saddled companies with a greater share of the economic costs of mining. As they were forced to pay more to reduce water contamination and sulfur-dioxide effluents, 6,500-year-old mining technology became impractical. Without regulation, it is unlikely that the mining industry would even now be beginning its long trek toward post-industrial techniques.

The Bush administration needs to step forward with a commitment to forging a partnership among industry, academia, and government to promote R&D on biohydrometallurgy, a recommendation made in a 1988 Office of Technology Assessment report on the copper industry. Such an initiative could move the U.S. minerals industry into efficient, environmentally compatible metal production and spread the costs and rewards of R&D so no one company need take the risks alone. The Department of the Interior, which has responsibility for national parks and oversees the Bureau of Mines, should form a new agency to guide this function. The agency would assist university and private-sector research as well as catalyze the formation of a research consortium among mining companies.

It is also critical that public policy regarding genetically engineered organisms in mining be reviewed. Current regulations have been developed to fit what have now become the traditional fields of genetic engineering—agriculture, pharmaceuticals, and medicine. However, the guidelines fail to account for the unique aspects of the organisms for biohydrometallurgy. Most important, they are chemolithotrophs—that is, they derive their energy from chemical sources, not from living or formerly living organisms. Consequently, the danger to human beings, plants, or animals is very low, and the risks associated with environmental release are likely to be several orders of magnitude smaller.

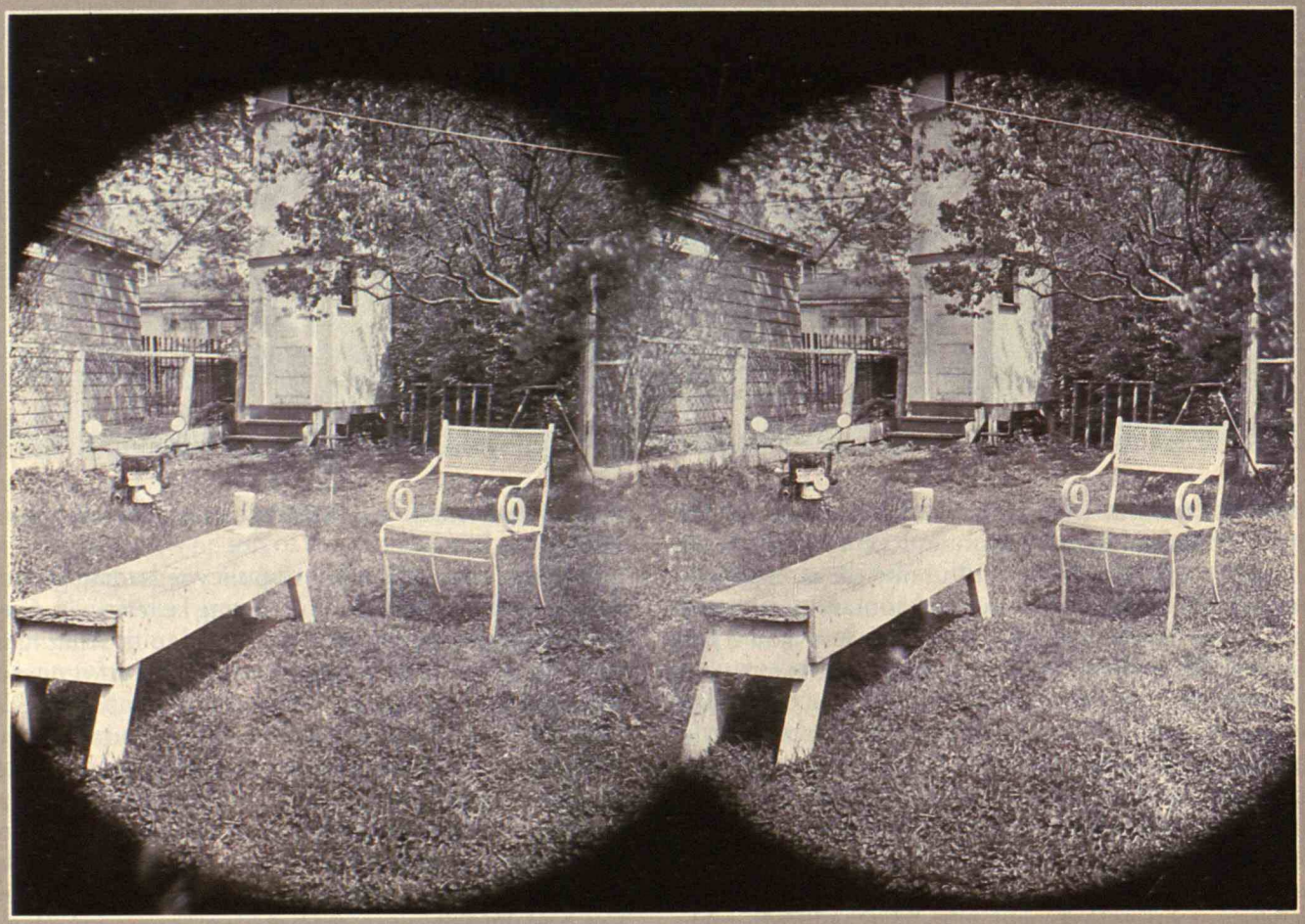
In fact, many researchers worry about the opposite problem: that an engineered organism won't survive in competition with wild strains. Like a rose in an untended patch of weeds, the organism might be overcome by competition with those that have evolved over millions of years to most efficiently exploit a specific ecological niche.

Finally, the mining industry needs engineers and scientists trained in biohydrometallurgy. Mining engineers are educated in chemistry, physics, and various engineering disciplines but rarely in biology. The nation's mining schools need to add this critical component to their curricula if these processes are to be adopted and properly engineered.

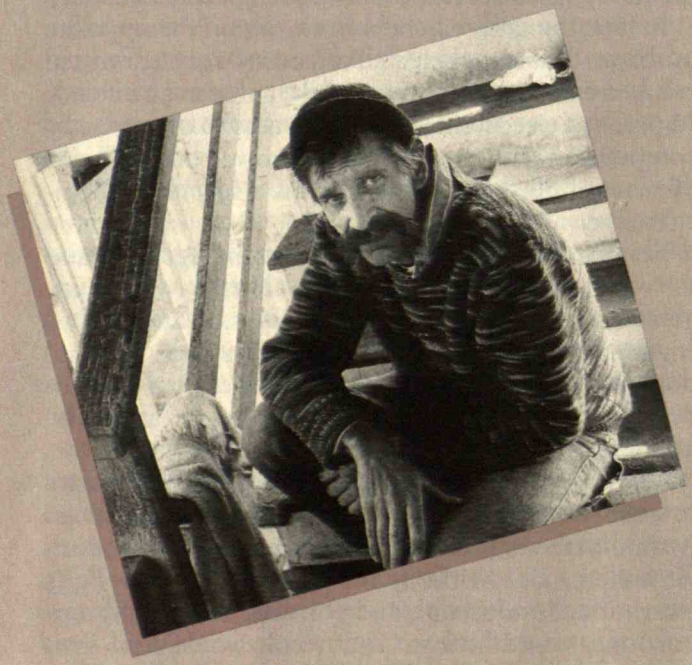
The U.S. mining industry has a unique opportunity to serve two often conflicting goals of industrial society simultaneously: efficient production and a clean environment. But without the initiative of America's educational, industrial, and political leaders, this opportunity could be lost. That result would have lasting impacts on both America's industrial vigor and its environmental health. ■

PHOTO: BOOJUM RESEARCH LTD.

Radically Recycled Cameras



"Overlapped Stereo Image" 1989 Silver Print



"5 x 7 Stereo Camera" 1984

Jno Cook (lower left) is after photographs that are impossible to take with conventional store-bought technology. He put together the stereo camera shown here because he "wanted to know what images would look like when partially overlapped."

PHOTO OF JNO COOK: MICHAL ENSDORF

Photographer Jno Cook decides what pictures he wants to take and then builds the right cameras to take them—using materials that are commonly known as junk.

Jno Cook wants to democratize the technology of photography. There are more and cheaper ways to take a picture than the companies that manufacture cameras would lead you to believe, the Chicago photographer asserts, and the cameras he has constructed from apartment-door peepholes, cookie tins, cardboard boxes, and various used spare parts prove his point. The prints that result are noteworthy, too: not only are they beautiful, but they show how much sheer aesthetic freedom is possible for those who refuse to passively accept whatever pricey, touch-me-not technology the photo industry dishes out.

With degrees in electrical and industrial engineering, Cook is naturally more intrepid than most about taking technology into his own hands. But he insists that other people could do the same things he has done as long as they're willing to invest a little time and effort. "Cameras and lenses date from the thirteenth century, and the principles of their operation can be summed up on the back of an envelope," he has written. "In building or modifying my equipment I have not used any knowledge that could not be found in high school texts on geometry and physics." To inspire others to educate themselves and embark on experiments of their own, he exhibited his funky, odd-looking homemade cameras last year at the Randolph Street Gallery in Chicago, and recently at the List Visual Arts Center at MIT.

As all this suggests, Cook's approach to both technology and art is thoughtful, original, and—especially—humanistic. In the following conversation with Technology Review *associate editor Beth Horning, he reveals more about that approach.*

"Pinhole/Snapshot" 1980 Silver Print

"Modified Polaroid Pack Film Camera" 1980

A simple lens Cook added to this sawed-off Polaroid portrait camera "produces an extremely wide angle with pin-cushion distortion and a large fall-off of light away from the center," he explains. These photos of his family demonstrate what strong images the contraption can yield.

TR: One of the most interesting things about your background is that you didn't get your master's of fine arts until you were 43 years old. Before that, all your formal education was in engineering. How did you make such a switch? And when did you begin calling yourself an artist?

JNO COOK: First of all, calling yourself an artist is something you just have to get used to. It takes a while before you can do it without wincing. But it was clear to me early on that I couldn't stand the jobs I was getting with my engineering degrees. I worked mostly in management, either for the Chicago Transit Authority or the State of Illinois, and I kept quitting because I was too bored. For example, I was very efficient at what I did for the State of Illinois, so I would be through with everything 15 minutes after I got to the office and there would be nothing to do the whole rest of the day. I'd still have to hang around, though—just in case the phone might ring. It drove me nuts.

Anyway, during the 1970s when I was continually taking these furloughs from the business world, my father died. One of the things that made it especially sad was that since this happened only a year after he'd retired, he'd never had a chance to pursue his interest in sculpting the way he'd planned to. So I decided I had to do it myself, and I began to take courses with the Clay People, who ran what was probably the largest unaccredited clay school in the country.

That was some of my first exposure to artists and their way of looking at the world. A woman I knew there would get totally interested in things like "granularity"—I helped her move once and

"Pinhole/Snapshot" 1980 Silver Print

some of the stuff I had to carry were bags of wood shavings and curlicue pieces of metal that had come off a lathe. She also used to plant fluorescent tubes in the ground just to have them stick up into the air. Well, I didn't quite understand any of this. But I slowly came to appreciate it, and what I realized, I think, is that one of the things you're allowed to do as an artist is simply play around. You get to have fun.

So there was that very basic but crucial lesson, and then there were lessons in technique, too, some of which had to do with photography, another hobby that I was involved with around that time. A friend of mine who had seen a show of my photos at a cafe told me, "You don't know how to print," and I resolved that I would find out, which led me to take some introductory photography courses at Columbia College here in Chicago. By the time I got through with those I knew how to print.

The last course I took at Columbia was called "Generative Systems," where the emphasis was on expression rather than on the mechanics and pyrotechnics of photography. It was the sort of class where the students were calling themselves *artists* and their work *art.* And at that point I met a woman who was about to enroll in the MFA program at the School of the Art Institute of Chicago and she said, "Hey, Cook, why don't you apply, too? Then we can both play for a couple of years." So I did, almost on a lark.

TR: But you were accepted.

COOK: Right. And when you get accepted to a prestigious place like the School of the Art Institute, you don't argue. You just go. I immediately set out on a five-year plan

Artists have always worked in dead technologies—those that have come to their useful end.

"Horses In The Lawn" 1988 Silver Print

"Camera-Box Pinhole Camera" 1987

The dream-like picture above was taken with a camera Cook made out of the box that a "real" camera came in.

to reduce my desk job to zero hours and make a living through part-time work. I was convinced that being an artist was a viable alternative for me.

Because especially in those days acceptance into the MFA program was everything—there weren't really any required courses in the graduate division. There wasn't a requirement for a final show or thesis. You could take the same class over and over, or take no classes at all, or take classes in a completely different field. Instructors in the photo department would sit down and do a critique on painting or performance or video without batting an eye. It was a real education after Columbia College, where photography is photography and nothing else. Whatever tendencies I'd ever had to experiment were definitely reinforced.

But there was also another side to the experience, because most of my fellow students had begun taking their art seriously in high school. Starting at the MFA level made me an outsider, almost a primitive.

TR: It's not as if you were a blank slate, though. After all, you'd had pretty substantial training in engineering.

COOK: And I was an adult with some clearly formed opinions. But yes, I can't just dismiss the engineering background. It gave me a lot of confidence with materials, as well as an ability to go directly to the core of a problem and find the resources for solving it. Engineering school teaches you how to work like a maniac, too, which is something I still appreciate. One of my strengths is that I will work on something continuously until it is done.

Even so, there are things engineering students just miss out on—all of literature, for instance. Granted, you do have some kind of "humanities" requirement, but people can generally get half of it out of the way by taking Psych 101 and reading about Pavlov's dog. Also, with all the stress on solving problems, you never learn that some simply don't have solutions, as in politics and social dealings. Then finally—and this is es-

pecially relevant—you never learn that some solutions result from inexplicable intuitive jumps instead of step-by-step linear thought. Artists, on the other hand, are quite aware of intuition and rely on it heavily.

TR: Are you saying that there's no room for intuition in engineering?

COOK: Not exactly. For one thing, the familiarity with materials and processes you acquire as an engineer can allow you to make real leaps in your thinking. But the point is that eventually you have to back up everything you do with orderly facts and calculations.

I suppose what it boils down to is that engineers just have a different perspective. Let me give you an example. Artists who see an exhibit of my cameras seem to marvel at the fact that these objects look as if I assembled them from odds and ends I picked up off the floor. They apparently have this image of me walking around in my basement saying things like, "Yes! *This* could fit *here*! And let's see now . . . that *hinge* would be appropriate . . . *there*!"

TR: Whereas you don't work that way at all.

COOK: Well, to tell you the truth, that really is the way I work a lot of the time. But I'm also capable of assembling apparently unlikely parts in a very methodical way, without any particular recourse to intuition, which I suspect has something to do with my engineering background. Because friends of mine who are engineers will have a much more matter-of-fact response to the very same exhibit, even if they like it. They'll simply see the cameras as the only logical assembly of available parts that would accomplish a specific design purpose.

What strikes me is that even if engineers do find themselves using intuition, they often limit themselves because they don't necessarily value it or take it seriously—while artists focus on intuition almost exclusively and go out of their way to cultivate it. Sometimes a bit too far out of their way, in my opinion. I get impatient with artists who take an intuitive approach when a rational solution would do as well and give results more quickly.

I have other attitudes that come directly from four years in engineering and natural sciences and remain unadulterated. To be specific, I am intolerant of work that passes itself off as broadly metaphorical, or that presumes to mythologize. And I usually dismiss work that is based on a shallow understanding of materials or subjects. Few artists object so strenuously to anything anyone else is doing. For the most part, they're quite generous with one another—it's something you learn in art school. But I myself cannot see creating without a purpose.

TR: Could those attitudes also have something to do with the fact that until you were 12 years old you lived in Holland, where so many of the people are pragmatic, down-to-earth, and Calvinist?

COOK: Undoubtedly. But one of the main effects of coming to this country from Holland has been just to make me thoroughly aware of what it's like to be an outsider—so it seems we're back to that whole issue again. Being an engineer in art school was a pretty uncomplicated experience compared with what I went through as an immigrant in junior high. The most amazing part of it was that I had to learn a new language from scratch.

TR: Don't the majority of people in Holland speak English and several other languages as well as Dutch?

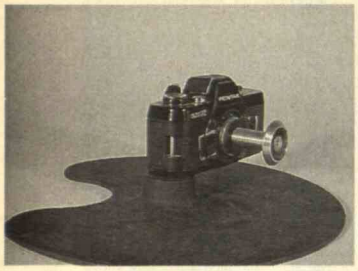
COOK: Not when they're 12 they don't. It's mostly in high school that you learn languages; when I left Holland I couldn't have told you much more than "what o'clock" it was in English, and in French I hadn't moved beyond *la mère* and *le père* and "*la plume* is on *la table*."

Basically I was a socially backward kid who couldn't even speak to his peers. I spent the seventh grade wondering what on earth the teacher was talking about. I did learn English, and rather quickly—to the point where I thought in English by age 16. Even so, I managed to do it without a single idea of how, which has bothered me for the rest of my life. As a 6-year-old you can pick up languages without thinking about it, but as a 12-year-old you feel that you should have some awareness of the mechanism of learning.

The result has been that I've become fascinated with the way learning occurs, which

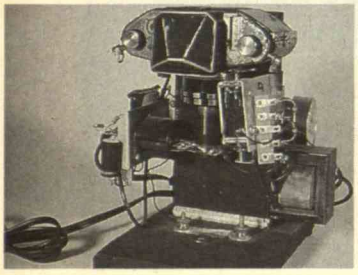
I am intolerant of work that presumes to mythologize. And that attitude comes directly from four years in engineering and natural sciences.

"110 Fish-Eye Camera" 1985



"120 Panoramic Camera" 1988

"35mm Cockroach Camera" 1978



Top: Cook got a Pentax for nothing—and since it didn't have a lens, it wasn't worth much more. But he solved the problem handily with an apartment-door peephole. Middle: This camera fashioned from a cookie tin is designed to produce a 360-degree panoramic photo. Bottom: One of Cook's most ingenious cameras photographs cockroaches at the moment they are electrocuted. Two pieces of tinfoil are mounted below, and when the insects step on both at the same time, a 120-volt triggering mechanism goes off.

shows in much of what I produce, although I'll often just document the traces of the learning process. For example, I once put together a book about a three-year-old who was acquiring the ability to draw pictures. There was no text, only a series of images that went from blobs with faces to fully articulated figures, with intermediate steps like houses with legs—it presented all the data, but no particular insight into what was going on.

TR: Some of your interest in the workings of the brain seems to come through in the cameras you make. At your recent exhibit at MIT, I was looking at your "stereo" camera, which gives you pictures with two identical but slightly overlapping images, and I thought, "Oh, I know what this is. He's wondering what the world would look like if somehow we couldn't integrate the information coming in from our right eye with that coming in from our left eye."

COOK: Well, that's going too far. I've never made cameras as psychological studies or interpretations of biology or inquiries into what it would be like to be cross-eyed—which is why I use deadpan titles that just give the size and use.

In fact, building these devices is a completely secondary activity: it's the photographs I can take with the cameras that interest me, not the cameras themselves, which often fall into a state of total disregard and dismantlement once I've got whatever results I'm after. It never even crossed my mind to display them until the Randolph Street Gallery in Chicago asked me to, and when that happened I had to go into my workshop and start finding things in boxes and putting parts back together again.

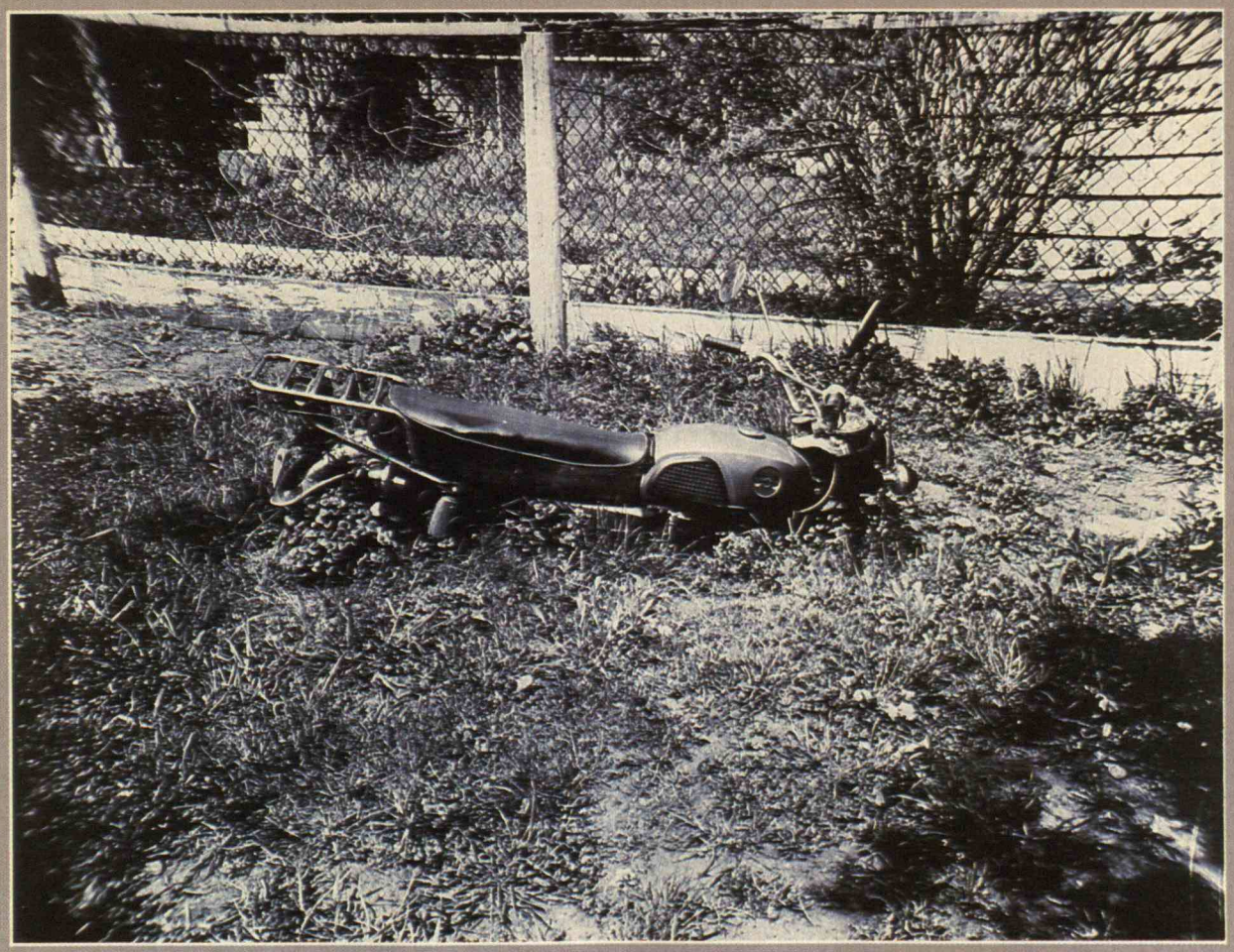
TR: If you have such a casual attitude toward your cameras, how could you go along with the idea of exhibiting them? I know that demystifying technology is important to you and that your shows are a way of telling people "if I can do this, you can, too." But as long as works of yours are sitting in a gallery, some people are inevitably going to look at them as art in themselves—as sculpture—regardless of your didactic intent. Are you comfortable with that?

COOK: Yes I am. I've come to accept the cameras as sculpture, even though they weren't initially intended that way. I understand, also, their appeal as sculpture. They clearly reveal an attitude, and what's especially nice about them is that the steps I went through to make them show through clearly: at the base level, art is always about the process of making art, and anything that strikes home reveals its process in the final product. The point is that you can almost tell by looking at these cameras how I work, which is very opportunistically, using materials I acquire through serendipity or through this bizarrely detailed visual memory I have of where I've seen what in hardware stores. Sometimes I'll go for months or years without doing anything on a camera and then suddenly a part I need for it will turn up out of nowhere. And some of my ideas come from the cameras themselves: they simply ask to be made into this or that.

Also, these cameras, when they're on display in a gallery, assume a life of their own. Partly it's because they have this potential of taking pictures—of being image-makers—but they're not in use; they've become objects of contemplation. They're all sitting on pedestals or shelves or whatnot. Another interesting aspect of the cameras is that I'm asking the viewer to take a conceptual leap between image and image-maker—a leap similar to the one I had to take to build the cameras in the first place.

TR: Even though you've been so successful in working cheaply, using only whatever materials you happen to come across, do you ever think about what it would be like if you had unlimited funds and access to state-of-the-art equipment in mint condition?

COOK: Let's put it this way: I'm not about to refuse a Rockefeller grant for an all-new something-or-other, but on the other hand, nothing I do is so dear or so concentrated that I would need to invest a huge sum of money in getting started. If a foundation doesn't give me the financial backing I want for a project, I can always scale it down or move on to another. That's part of working opportunistically—I'm not going to let lack of money hold me back. I'm not going to stay out of video, for instance, just because I can't spend $300 an hour to edit my tapes on a console the size of a wall.



"Backyard In Summer" 1989 Silver Print

Then, too, there's the fact that art has never been dependent on highly sophisticated, up-to-date technologies anyway. Artists have always worked in dead technologies—those that have come to their useful end. Maybe painting is the prime example. Now that photography has been invented and you can get an image almost instantaneously, what could be more backward than laboriously putting down little dabs of paint with a brush? Or take lithography. Its original purpose was to make multiple copies of images, which means that it should have vanished into obscurity when the printing press took over that function. Yet both painting and lithography are high art forms today.

TR: In much of your work, you seem to be preoccupied with the "candid camera." You set up cameras that take pictures every hour no matter what, even when people are eating or sleeping or making love. What draws you to that approach?

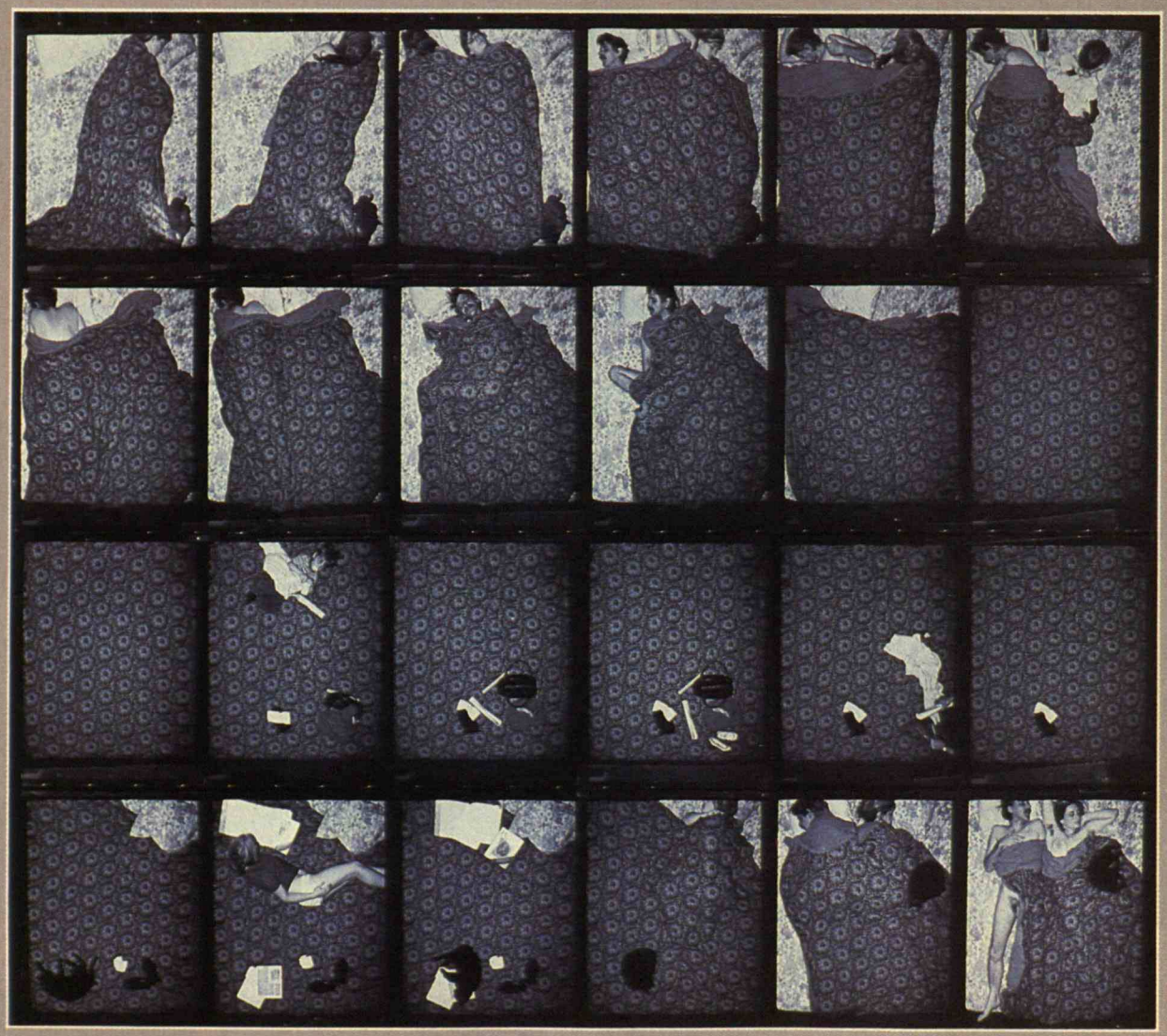
COOK: Partly it's data collection. I've chosen the hour interval because our lives are run by hours that continue even when we defy them by engaging in an activity where we lose track of time. I get the pictures, arrange them in sequence, and leave viewers on their own to draw a conclusion or just delight in the research, as I do myself.

There's an aesthetic at work, too, although it's not the kind that's crafted as in painting. The idea is that the world has an inherent beauty that will become clear if you let it. All you have to do is set up some parameters, like the hour inverval, and the thing goes by itself—the aesthetic is out there in ordinary physical reality like everything else.

TR: I've noticed from your photographs that you often define "out there" rather narrowly. About as far afield as you usually go in pursuit of this ordinary physical reality is your backyard, whereas other photographers travel widely, taking pictures of

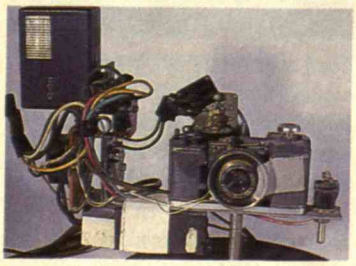
"11 × 14 Box Camera" 1987

Cook uses his 11-by-14 box camera to photograph his backyard, which features a variety of bizarre attractions, including this partially interred motorcycle. "It was trying to kill me," he claims, "so I buried it."



"Motordrive" 1980 Silver Print

"Half-Frame Motor-Driven Camera" 1978



Cook mounted his half-frame motor-driven camera over his bed and set it to take a picture every hour. "It would go for three days before running out of film," he says. "We didn't notice the flash after awhile."

celebrities and total strangers. Why have you made such a choice?

COOK: Well, in fact my work really isn't just about my family and my backyard, even though they are the nominal subject matter. One of my premises is that whatever message I could possibly want to convey is most clearly defined in the experience of my own life, in the most familiar of what I see. The larger social situation is embedded in those images. And in truth the content of my art varies considerably: I've done work on having children, as well as on our society's propensity for violence, TV as cultural storyteller, and personal tragedies—losing custody of a child, divorce. I'm sure the future will bring old age and death forward as subjects.

But when that day comes, people won't take one look at my photos and say, "Oh yes, old age and death obviously, how moving." Because like other artists, I shy away from easy-to-read visual language. After all, that sort of thing is owned by advertising. It's much more interesting to investigate language at the boundaries of established meaning, or to venture into new territory, beyond the comprehensible. It's that very exploration that keeps me interested. ■

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Mumford's Hope and Our Future

OF thinkers who have tried to fathom the meaning of technology, none probed deeper than Lewis Mumford. Although his later writings issued stern warning that modern society had blundered onto an errant path, his underlying message was one of hope and renewal.

From his first writings in the 1920s until his death earlier this year, Mumford sought to reveal the connection between the human spirit and the character of our technological works. He believed that the most impressive technical triumphs are projections of humanity's spiritual needs. By the same token, work with technology stimulates an orderly, creative response within human consciousness—the development of symbols, mental images, and language. Our deepest ideas and our material projects continually mirror each other.

Mumford celebrated "technics" not only because it contributes to material well-being but also because it can express the highest aspirations of the human psyche. He believed that people achieved their greatest fulfillment through creative work, including technological undertakings. In that sense Mumford was the most extravagant of technological optimists.

His understanding of what is beneficial in technological change, however, put Mumford at variance with orthodox conceptions of progress. The standard belief is that humans are primarily tool-making, tool-using animals whose greatest accomplishment is the conquest of nature. In this view, history shows a steady accumulation of technical advance for the general good. Efficiency is seen as a universal goal: society's mission is to race forever forward along technology's cutting edge.

Mumford criticized this "myth of the machine" for its narrow materialism and its one-sided rationality. He vehemently denounced the interlocking web of corporations, bureaucracies, military forces, and mass media that embrace the myth as gospel. Mumford warned that a grotesque "megatechnics," propelled by an ever more frantic quest for productivity, profit, and power, was running roughshod over nature and the best of human capabilities. As he explained in *The Pentagon of Power* (1970): "I have been driven by the wholesale miscarriages of megatechnics to deal with the collective obsessions and compulsions that have misdirected our energies and undermined our capacity to lead full and spiritually satisfying lives."

America's greatest philosopher of technology left a legacy of optimism and renewal.

Mumford's criticism of what he considered modern society's destructive tendencies brought predictable countercharges that he was merely a doomsayer. Even well-placed academics, who should have known better, tarred him as antiscience and antitechnology.

What angered them was that Mumford had called their bluff. He was asking, in effect: If scientists and technologists are genuinely committed to human well-being, why are they so deeply involved in the arms race, the destruction of the environment, the development of depersonalized institutions, and the perpetuation of mindless consumerism?

Mumford never opposed technology per se. He criticized instead the particular technological path our society has chosen to follow. Mumford tried to point out alternative forms of technology culture to which we should aspire. His books provide a wealth of practical suggestions for democratic enterprises on a modest scale that apply technology in graceful harmony with nature and with our fellow human beings.

Many of today's discussions about technological and social change retrace steps that Lewis Mumford took long ago. The revival of the environmental movement echoes ideas for ecologically sound relationships between city and country he advanced in the 1920s as cofounder of the Regional Planning Association. The fervent calls for redirecting military production to serve domestic needs mirror suggestions he made during the Vietnam War. Concerns about U.S. manufacturing competence inevitably return to one of his central themes: that the success of an enterprise ultimately depends on each individual's creative intelligence—a quality that Mumford believed was smothered by assembly-line production.

Mumford thought that his generation had stumbled badly in its approaches to industrial production, city planning, transportation, and most other areas of social policy. But he maintained his faith that later generations would acknowledge these failures and begin a serious quest for alternatives. This turning could renew the beneficent process of development at the root of human history and restore prospects for an agreeable future. As he wrote in *The Pentagon of Power:* "For those of us who have thrown off the myth of the machine, the next move is ours: for the gates of the technocratic prison will open automatically, despite their rusty hinges, as soon as we choose to walk out." ■

LANGDON WINNER teaches in the Department of Science and Technology Studies at Rensselaer Polytechnic Institute. His most recent book is The Whale and the Reactor.

ILLUSTRATION: BETHANY GULLY

Biology Breakthrough

IN their quest to learn about life, biologists can travel only as far as the available technology will carry them. Tools such as the electron microscope, modern separation methods, and recombinant DNA techniques have radically affected the speed and quality of investigation.

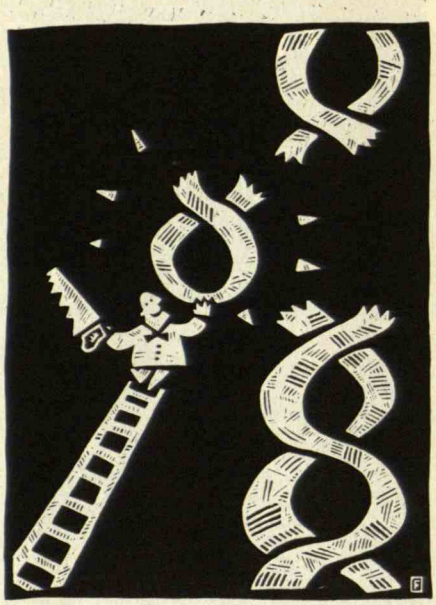
Now we are in the midst of yet another technical revolution. I refer to the ability to inactivate, or "knock out" a specific gene in a mouse. It has long been possible to alter genes or add new ones randomly. But now, with the ability to target specific genes, the technology will have an extraordinary impact on research.

The significance of this technological feat becomes clearer when it is put in historical perspective. Twenty years ago, only the genes of bacteria and viruses were open to manipulation. These single-cell organisms have relatively few genes, which can be studied by modifying natural processes.

The advent of recombinant DNA techniques in the mid-1970s gave biologists the power to find, manipulate, and characterize the genes of multicellular organisms—even human beings. We could not only study genes in isolation but also put them into cells. That way we could find correlations between a gene's structure and its function. But still we could not directly probe the role a specific gene plays in the life of an animal.

Now we can. The latest developments permit us to obliterate or modify a single gene in a mouse and so probe the role of the gene in the life of the organism. To understand the functions of a human gene, we can look for the equivalent gene in the mouse, knock it out, and examine the consequences. Recently, for example, Maarten Zylstra and Rudolf Jaenisch at MIT's Whitehead Institute inactivated a gene thought to have wide significance in immunology and development. The expected effects on the immune system were observed but those on development were not, greatly clarifying our understanding of the gene's role.

This experiment was possible only



The ability to inactivate specific genes in mice heralds a new epoch in biotechnology.

because of an extraordinary sequence of technical advances. First, biologists had to learn how to take cells from very early embryos and grow these cells in an artificial culture medium. This barrier fell several years ago, thanks primarily to the work of Martin Evans and Elizabeth Robertson at Cambridge University. Other researchers then showed that when reimplanted into an embryo, after months or even years in a petri dish, these cells would contribute to the adult animal's genetic makeup.

These manipulations made it conceivable to alter the genes in the embryonic cells and then grow mice with the altered genetic structure. Until recently, however, genetic engineers lacked the ability to modify a specific, preselected gene. Mario Capecchii of the University of Utah deserves major credit for figuring out how to knock out specific genes.

An obvious question is whether the technique might be used for gene therapy in humans. This possibility remains far off. As now practiced, the technique is highly inefficient and inexact. Moreover, it requires culturing cells for very long periods before they are reimplanted in an embryo.

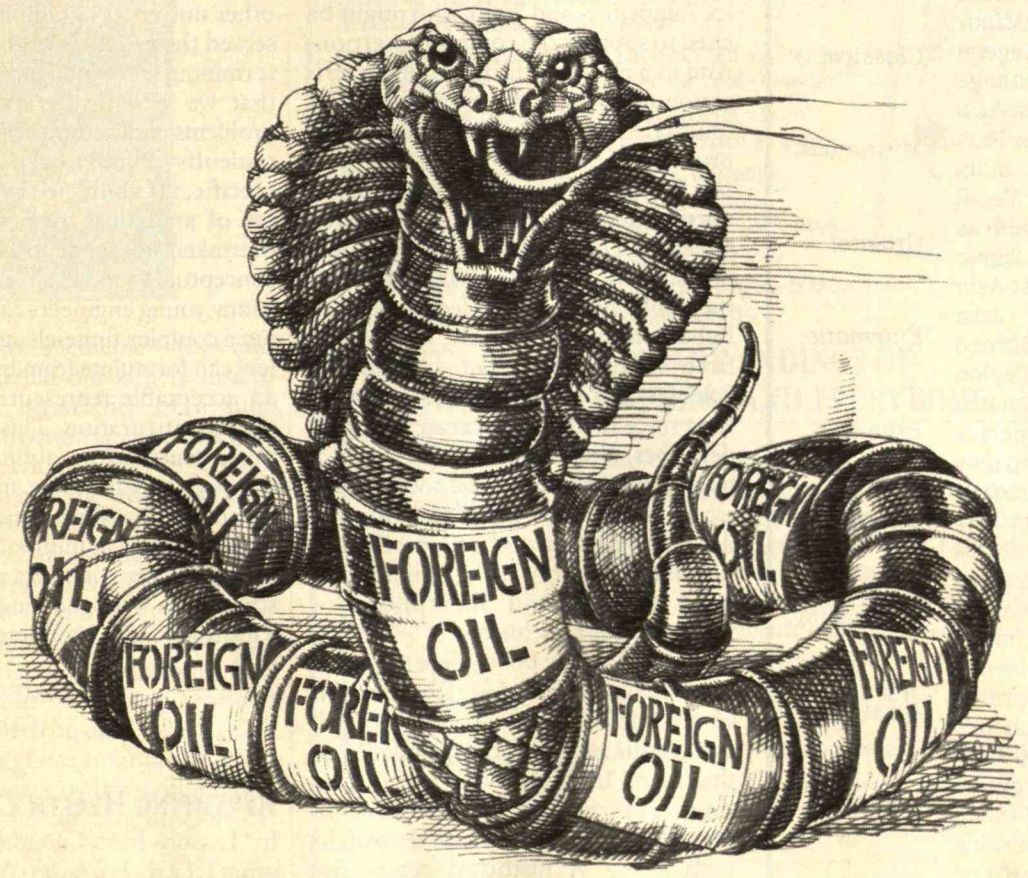
Because gene knockout technology puts a premium on experimentation with intact mice—as opposed to the cell-culture and biochemical work that has characterized much of vertebrate biology in recent years—it will transform the practice of biomedical research. Greater dependence on mice will require improved, state-of-the-art animal facilities. Animal physiologists, whose skills have been out of fashion for 20 years, will find themselves in great demand. The high cost of maintaining mice will make research more expensive; some laboratories already must strain to pay their mouse-keeping bills of $50,000 to $200,000 or more per year. Because these experiments take so long, the advent of gene knockout technology is likely to exacerbate a trend toward longer training periods for students and postdoctoral workers. It is also liable to intensify the pressure to concentrate research at large laboratories because so many diverse skills go into such experiments.

This revolution brings closer the day when the extraordinary modern advances in basic biological knowledge can have a wide impact on human disease. It completes the chain from finding specific genes to studying their effects in the whole animal. With this knowledge we can more confidently apply laboratory science to treat patients and can better understand how to counter disease.

For perhaps 15 years biologists have felt that there was no limit to the detail in which living processes could be understood. But our optimism was an act of faith—an extrapolation of the successes of the past. The new technology affirms our faith that routes to progress open when thoughtful people apply themselves to key questions. ■

DAVID BALTIMORE is president of The Rockefeller University in New York.

ILLUSTRATION: FRAN O'NEILL



THE KISS OF DEATH?

We now import more than 40 percent of all the oil we use, and that percentage continues to grow. This excessive dependence on foreign oil could poison America's economy and our national security if our supply were ever disrupted.

But the more we use nuclear energy, instead of imported oil, to generate our electricity, the less we have to depend on uncertain foreign oil supplies.

America's 112 nuclear electric plants already have cut foreign oil dependence by 4 billion barrels since the oil embargo of 1973, saving us $115 billion in foreign oil payments.

But 112 nuclear plants will not be enough to meet our rapidly growing demand for electricity. We need more plants.

Importing so much oil is a danger America must avoid. We need to rely more on energy sources we can count on, like nuclear energy.

For a free booklet on nuclear energy, write to the U.S. Council for Energy Awareness, P.O. Box 66080, Dept. SK19, Washington, D.C. 20035.

U.S. COUNCIL FOR ENERGY AWARENESS

Nuclear energy means more energy independence.

conservative or even reactionary authors, including William Butler Yeats, T.S. Eliot, Matthew Arnold, and Homer, but ignores authors such as Plato, Augustine, and Swift who might be cited to support the contrary assertion. And as a matter of fact, the characterization of Yeats as reactionary is most unusual. This is the same man whose production of J.M. Synge's *Playboy of the Western World* so offended public sensibilities as to cause riots in the streets of Dublin. One of Yeats's own plays, *Cathleen ni Houlihan,* inflamed the public passions that led to the Irish Rebellion of 1916. Finally, the excerpt from "The Second Coming" that Mr. Schlefer quotes is particularly inopportune since the full context of the poem describes Yeats's belief in a cyclical balancing of historical and social opposites. The poet may at times be depressed or alienated, obscure or allusive, but never shrill. Mr. Schlefer mistakes image and metaphor for fundamental conclusions.

Another aspect of the piece that gives me difficulties is the description of how writers look to the past while technologists evaluate present data and look to the future. If physical observations are the data of science, where else but in history or prior writings are the data of the humanities? A historical perspective does not imply a reactionary outlook. The insightful poet, playwright, novelist, or historian seeks to illuminate the subtle or hidden corners of human experience so that the reader may gain an understanding not readily acquired by other means. One may argue that human behavior has changed little in the past two (or more) millennia, and that reinterpretation of the past is therefore hardly less liberal than a physics experiment.

However, I agree with Mr. Schlefer that caution is needed in the effort to modify the humanities curriculum at MIT. Educators must establish a basic aptitude for critical inquiry as well as for written and verbal expression. The breadth of exposure to particular types of literature, history, or philosophy is much less important than developing ways of thinking that allow the individual to face novel situations.

As a practicing engineer and sometime supervisor of recent MIT (and other university) graduates, I have observed the products of today's scientific training firsthand, and I've concluded that we are already starting to have problems with certain other educational tradeoffs schools have made. To be specific, the ability to use the widest array of analytical tools seems to have overtaken a deeper consideration of the conceptual foundations of engineering. Many young engineers can perfectly input a complex finite-element model, but few can formulate from basic principles an acceptable representation of some novel configuration. This places far too much trust in the ability of tool developers to formulate menus encompassing all possible difficulties. It also leads to a faith in numerical results that can easily get engineers into trouble. I sometimes wish that engineering education were still conducted with a slide rule.

JAMES J. GORMAN
Cambridge, Mass.

REVAMPING HEALTH CARE

In "Lessons from Canada's Health Program" (*TR February/March 1990*), Milton Terris accuses doctors of "ruthless business practices" and inveighs against the fee-for-service system as inviting abuse through exorbitant fees and unnecessary operations. In its place he proposes annual budgets channeled through provider organizations.

Although Mr. Terris mentions several other factors that drive up the cost of medical care—among them new technology and the aging population—he dismisses them as irrelevant. I submit in response that a host of commonly performed innovative procedures have had a significant impact on the national health budget by extending the span of life for premature infants on one end of the scale and the elderly on the other. Mr. Terris also omits any reference to the malpractice situation, which takes its toll not only in premium costs but

also in "defensive medicine"—tests and procedures carried out largely just to stave off the possibility of a suit. Moreover, he mentions neither the cost of the government's health-care financing apparatus nor the administrative overhead practitioners face.

Finally, the characterization of physicians as unscrupulous exploiters of the public and private purse is grossly unfair. I must point out on the subject of caesarian sections, for example, that these operations are not performed "without regard to medical necessity," as Mr. Terris suggests. Infants surviving with brain damage owing to ill-advised vaginal deliveries are a significant liability.

The fee-for-service system has worked too well in America to be abandoned. And Mr. Terris's idea of a predetermined medical budget does not inspire confidence. On the other hand, it cannot be denied that much of our population is medically disenfranchised. A reasonable solution might be an expanded Medicare or Medicaid program financed by a Social Security surtax, or, as Mr. Terris suggests, we might adapt the Canadian pattern of taxes that increase with income. In any case, the major goals should be uniformity, consistency, and bureaucratic restraint.

WALTER LEWINNEK
Merrill, Wis.

"Lessons from Canada's Health Program" is pamphleteering masquerading as news. In his enthusiasm for bringing

the Canadian system to the United States, Milton Terris has apparently failed to discuss with Canadian women the potential impact of waiting four to six weeks to see their doctor. A Canadian woman I know recently assured me that she could go to the hospital instead, but would pay $85 up front for the privilege.

Neither the U.S. nor the Canadian system is without faults. Both could use a little antitrust action on the provider side—as well as a little more financial accountability on the user side, where abuses are disturbingly easy to commit. When I checked out of a U.S. hospital, I had to threaten non-payment of my share just to see an itemized statement. When I pointed out an error (to the hospital's favor, of course), my doctor, who was chief of staff, said, "Don't worry; your insurance will cover it."

LEWIS W. FLAGG III
Milford, Mass.

Hidden in "Lessons from Canada's Health Program" is the most unusual suggestion that care could be more equitably funded by "health taxes" on "hazardous" products. Included in the defined group of hazardous products are firearms.

I do not understand the grouping of firearms with products such as tobacco and alcohol that are demonstrably hazardous to health when used as intended. If the idea is to tax all products on the basis of demonstrated health-care costs regardless of circumstance, then surely we should start by taxing automobiles and gasoline, which produce far more costs than firearms. Perhaps we could then move on to a tax on pregnancy, which surely eats up a huge portion of the health-care budget.

The health-care costs associated with firearms consist almost entirely of those caused by their illegal use. A firearm is not intrinsically a hazardous product. As with countless other products, only the stupidity or criminal intent of the user makes it so. What Mr. Terris is suggesting is that millions of law-abiding and safety-conscious people should be made to subsidize the health-care costs resulting from the actions of a minority.

JOHAN P. BAKKER
Union Lake, Mich.

Reviews

CD-ROM

INTERACTING WITH MOZART

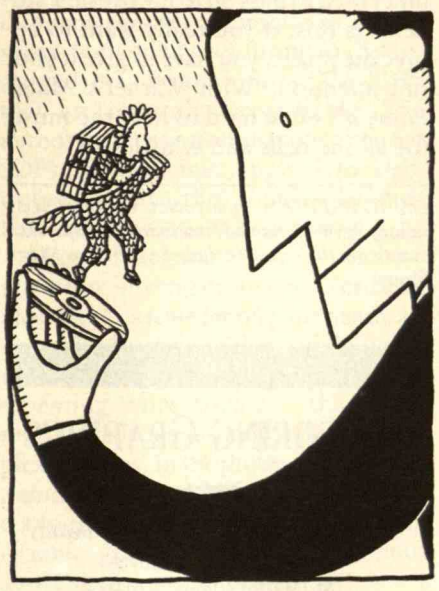
The Magic Flute
by Wolfgang Amadeus Mozart
Performance: Nikolaus Harnoncourt, Orchestra and Chorus of the Zurich Opera House
Annotation: Warner New Media
Warner Audio Notes CD-ROM, $66

BY DAVID BRITTAN

YEARS ago I taught a class in music history and appreciation. The history part was pretty easy. All I had to do was bone up on who wrote what when and encourage the students to do likewise. But teaching people to appreciate music proved a lot harder. To this day, I'm not sure it can be done. To explain music, you have to use words, which only get in the way. If Beethoven had felt that words could do justice to the knock of fate at the start of his Fifth Symphony, he might have written, "A descending third from a repeated dominant establishes the key of C minor" and saved the trouble of hiring an orchestra.

The Warner New Media CD-ROM version of Mozart's opera *The Magic Flute* runs into the same barrier. No amount of explaining and describing, even with interactive text and graphics running on a Macintosh computer, can make the music speak any louder than it did in 1791. Nevertheless, this first offering on Warner's Audio Notes label is marvelous in many ways. More than just a novelty, it shows that a musical work can be combined with the interactive features and large storage capacity of CD-ROM to create a product that entertains and informs—even if it sometimes frustrates.

For the musical backbone of the package, Warner has selected a fine 1988 digital recording in which Edita Gruberova shines as the Queen of the Night. To this the company has added



some 7,000 screens of information—musical analysis, plot synopses, the libretto in German and English, even a final exam—as well as spoken commentary and musical examples.

Before you can start exploring this interactive universe, you need certain equipment without which, apparently, no musical household is complete: an Apple Macintosh with a megabyte or more of memory, a compatible CD-ROM drive, and a stereo system (or at least a pair of headphones). To take full advantage of the package—which I did not—you'll have to drag out your synthesizer and your MIDI interface so you can play electronic-music versions of the main themes, and your laser videodisc player so you can watch a separate performance of the opera in synchrony with the CD-ROM.

As you've guessed, Warner's *Magic Flute* is not geared to a mass market. But families or schools that can afford all the hardware will find it as painless a way to listen to an opera as any.

For most people, the hardest thing about opera is not enjoying the music but following the story. Warner makes this easy. If you want, you can have the whole plot laid out for you, step by step, as you listen to the music. Or if you prefer to look at other kinds of information, a click of the mouse will return you to the story any time you get confused. Another way to follow the action is to read the libretto—the text sung by the characters. Although it's unfortunate that you have to choose between German and an English translation instead of seeing the two side by side, the package does something no printed libretto can do: it feeds you the text line by line as it's sung, like the "supertitles" used in a few major opera houses.

The dramatic side of the opera is also enriched by descriptions and histories of the characters. As Prince Tamino sings, you might opt to read some accompanying matter. Under "character": "Tamino is the story's hero, a prince from a far-off land who enters this new-to-him world of Egyptian mythology as an adolescent on his grand tour, and emerges at the end an Initiate in the wisdoms of the adult." Another listing, "Taminos in history," shows an engraving of the character from the 1792 vocal score, followed by eighteenth-, nineteenth-, and twentieth-century costume sketches and a rather low-resolution photo of tenor Charles Kullman as Tamino in a Metropolitan Opera production.

Much of the added material has a miscellaneous feel that suggests Warner is aiming at something not usually associated with music appreciation: fun. Musical "sidebars" allow you to stop the opera in its tracks and listen to the likes of New York socialite Florence Foster Jenkins, who, at an advanced age in the 1940s, recorded the famous Queen of the Night aria with rare incompetence. Another sidebar is inspired by the Three Ladies' patter song. It gives a history of the genre, complete with excerpts from the movie soundtrack of *The Music Man* and a photo of Robert Preston in the title role.

Warner's efforts to enliven the drama and history of *The Magic Flute* basically succeed. Less satisfying are the attempts to explain what's going on in the music. Each musical number is accompanied by an "analysis"—really a thumbnail description—that is useful mainly as a crib for music students writing papers on the opera. In an aria sung by

ILLUSTRATIONS: JAMES KACZMAN

Monostatos, we learn that the form is "introduction, aa′ba″," the key is C major, the tempo is allegro, and the meter is 2/4—revelations not likely to bring tears to the eyes of most opera lovers.

The running commentary that is also included bogs down in unilluminating detail. In one aria, we are told that "Tamino dips *chromatically* down to poignant, sentimental *appoggiaturas*. These are followed by a wild swoop up the biggest leap yet, a *minor* 7th, which, together with a *sforzando* full orchestra *chord,* accompanies the word 'Gotterbild/heavenly image.'" Fortunately, you can look up any of the italicized words by clicking the mouse. Unfortunately, anyone who knows or cares what they mean will get a lot more out of simply listening to the music than wading through the commentary.

In a way, the dreary analysis is redeemed by the medium of CD-ROM. When this sort of thing appears in print—say, on a record jacket—it's usually difficult to match the passage being described with the passage being played. But here, at least, the descriptions are cued to the music. Warner also lets you search through the commentary and click the mouse to hear any passage you want.

If one trait justifies CD-ROM as a musical medium, it seems to be this capacity for synchronizing audio and other sources. A "self-feeding" libretto like Warner's would enhance *any* opera recording. So would a feature that Warner somehow failed to include: an orchestral score where you can "follow the bouncing ball." A CD-ROM that lets one see exactly what notes are being played would benefit anyone who can read music, or wants to learn how.

Considering the enjoyment one can get out of such multimedia choreography, it's a shame that so much of the added material is *not* synchronized with the music. Character studies and other asides would work just as well in the low-tech medium of print as in the high-tech medium of CD-ROM. Here, in fact, they can lead the mind astray. A hint I used to pass on to my Music 1 students is this: if you really want to appreciate music, you have to give it your full attention. With Warner's *Magic Flute,* it's often hard to hear the music for all the bells and whistles. ■

DAVID BRITTAN, an associate editor of Technology Review, *attained "international superstar" status on the exam included with* The Magic Flute.

BOOKS

EXPLORING GRAPHICS

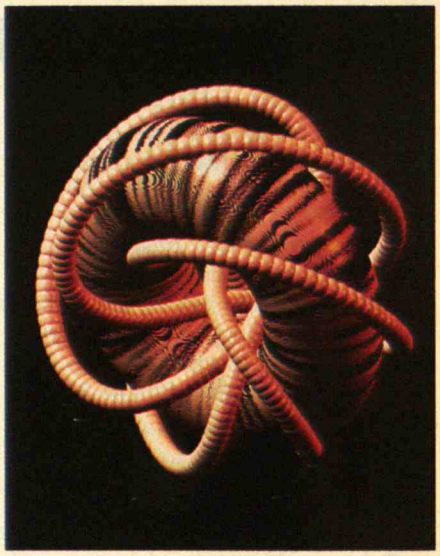
Computers, Pattern, Chaos and Beauty
by Clifford A. Pickover
St. Martin's Press, $29.95

BY PETER SØRENSEN

COMPUTER graphics has become indispensable in countless areas of human activity. The arts have been strongly affected by computer paint systems, synthesized special effects for motion pictures, and "3-D" television graphics, while industry has long used computer graphics in product design, engineering, and architecture. And from medicine to fluid dynamics, from atomic physics to astrophysics, there are nearly as many scientific applications of computer graphics as there are areas of study.

All this activity has spawned quite a number of books on digital imagery, most of which fall into one of two categories: those written for the layperson (which are full of glossy photos but generally short on meat), and textbooks for the programmer (which are largely indecipherable by anyone outside the field, and not likely to be illustrated very beautifully).

That's one reason *Computers, Pattern, Chaos and Beauty,* by Clifford A. Pickover, is so unusual. On the one hand, the scientist/artist author—an associate editor of *Computers and Graphics* magazine—eases the nonspecialist into this collection of essays by providing ample background information on computer graphics along with fascinating high-resolution images. On the other hand, he balances clarity with technical sophistication in accomplishing his main tasks: describing graphical methods for representing and detecting patterns in complicated data, and illustrating simple techniques for visualizing chaotic behavior. He augments this discussion with numerous "recipes" for recreating most of the graphics programs he has devised.



ONE OF PICKOVER'S PRIMORDIAL "BIOMORPHS."

In researching ways to visualize information, Pickover eschews the usual scientific method, whereby a problem is precisely defined and then narrowly investigated. Instead he casts his hook wherever the waters seem most fertile. He hops from fractals and chaos to the shroud of Turin, music, acoustic waveforms, genetics, snowflakes, and much more. Often Pickover applies software he has developed for one field to others where most people might not think to use them. For example, he used tools designed for speech synthesis research to find new ways of depicting the sequence of bases in a cancer gene.

Pickover extends the concept of fractals—geometric shapes that repeat

PHOTO: CLIFFORD A. PICKOVER

themselves on different scales—to encompass not just the seemingly chaotic systems like water and fire that they are known to underlie but also living organisms. His "biomorphs," a class of fractals he invented that look like primitive aquatic organisms, are an example. Pickover peers into these complex shapes as if they were drops of pond water under magnification.

The discovery of the biomorph creatures began with a bug in a program that Pickover and an associate had written to generate Mandelbrot sets—beautiful, infinitely complex fractal shapes created by the massive repetition of simple mathematical feedback loops. The bug caused triangular elements to appear everywhere in the fractal's pattern. By the time they had figured out what was wrong, the researchers were hooked by its unique aesthetics and went on to exploit it. Under their godlike control, the triangles evolved into tapered strands that remind one of the cilia, or tiny hairs, on microbes.

Biomorphs' uncanny resemblance to primitive organisms leads the author to wonder if fractals might lie at the root of the forms assumed by living things. He muses freely on where further work might lead: "Like ancient ants trapped in amber, the biomorphs remind us of the fossils of primitive life. If such complicated shapes can be found in the fabric of mathematical space formed with relatively simple equations, we might wonder if even 'higher' forms could be found by searching spaces defined by more complicated equations."

In his quest for ways to represent complicated data, Pickover has developed the deceptively simple "symmetrized dot-pattern," or SDP. The author has discovered that the human eye/brain finds graphs of acoustic waveforms much easier to digest if they are turned into six-sided patterns of dots like those of a kaleidoscope. He displays digitized sounds—human voices, animal vocalizations, and the beating of hearts in various states of health—in circular graphs with the threefold symmetry of snowflakes. In this way, sonograms representing the same vowel pronounced by different people, as unique as fingerprints but equally confusing to the untrained eye, become flowerlike SDPs that are instantly recognizable. The author foresees a useful application for SDPs in medicine: applied to electrocardiograms, they could make heart abnormalities easier to detect.

Many of Pickover's projects combine scientific investigation with aesthetic pleasure. His tessellation patterns are an example. Starting with a simple figure such as a triangle or squiggle, he applies repeating rules to make the figure reproduce itself automatically in complex patterns. In the process he not only demonstrates a kind of simplified ecology-on-a-computer—representing organic growth and life cycles—but generates exquisite mosaics.

Beyond its obvious contributions to research in a variety of fields, *Computers, Pattern, Chaos and Beauty* will awaken a wide audience to the astounding visual beauty hidden in mathematics and science. ■

PETER SØRENSEN is a computer graphics consultant based in Santa Monica, Calif.

BOOKS

POWER PLAYS IN SPACE

Communications Satellites: Their Development and Impact
by Heather E. Hudson
The Free Press, $24.95

BY ROBERT G. NICHOLS

CONVERSATIONS with commercial space advocates generally turn to the one successful space-based industry: communications satellites. After all, while space factories, power satellites, and lunar mining camps hold promise for the distant future, satellites for delivering television, radio, telephone, and other services are producing revenue today. Developing futuristic commercial space ventures, the argument goes, is a simple matter of duplicating the achievements of the satellite industry.

The success of communications satellites, however, has been anything but a simple matter. Despite the myriad benefits promised by this rapidly maturing technology, communications satellite services were slow in coming to the technically advanced nations. In developing countries, where they are needed most because they are ideally suited to reaching isolated areas, such services are still almost nonexistent.

In *Communications Satellites: Their Development and Impact,* Heather E. Hudson argues that the barriers have been institutional rather than technological. The director of the Telecommunications Management and Policy Program at the University of San Francisco, Hudson has produced a social, cultural, and political analysis of communications satellites. It is a story of political infighting, hidden agendas, and territorial intransigence.

The basic problem in Europe, as well as in Canada, Australia, and several other nations, is that domestic communications satellites are operated by those least likely to exploit them fully. The owners—government communications ministries in combination with established telephone and television carriers—jealously guard the earthbound services on which they are already earning income. While touting the benefits of satellites, these interests worry that space-based systems will successfully compete with, and perhaps supplant, terrestrial telecommunications. As a result, they drag their feet in implementing satellite services.

Canada, for example, launched its first operational communications satellite, *Anik 1,* in 1972. The Canadian government and the established phone companies jointly founded a corporation to run domestic satellite services, Telesat Canada. Telesat's owners saw communications satellites as an evolu-

Notes

Deep in China

U.S. planners could learn from Chinese underground housing and business complexes, according to Penn State urban designer Gideon Golany. He notes that many Chinese hospitals are underground to save energy. "Physicians in both China and Israel learned independently that post-surgery recuperation occurs 20 to 25 percent faster in an underground setting, since healing is promoted by a consistent, stable seasonal temperature and humidity."

Golany points out that "soil functions both as a heat insulator and heat retainer." The average natural temperature in buildings 32 to 35 feet underground would be 50 degrees in winter and 75 degrees in summer.

Soviet Anti-Semitism

The National Academy of Sciences has decried reports of anti-Semitism in the Soviet Union. "We have become greatly troubled by the information emanating from the U.S.S.R. that scientists who are Jews, and Jewish citizens of the U.S.S.R. in general, are the victims of harassment or worse."

The resolution urges Soviet authorities to "condemn these practices of anti-Semitism and persecution and use all legally available measures to prevent their further occurrence." It also observes that anti-Semitic attacks "will certainly undermine [*glasnost* and *perestroika*] at a critical period in the history of the Soviet Union and jeopardize international support."

No Post-Abortion Syndrome

The most scientifically sound studies all reject the contention of right-to-lifers that abortion threatens women's mental health, according to Nancy Adler and five others asked by the American Psychological Association to review the best available research on the subject.

"Although there may be sensations of regret, sadness, or guilt . . . legal abortion of an unwanted pregnancy in the first trimester does not constitute a psychological hazard for most women," the authors report in *Science*. On the contrary, studies consistently show "decreases in psychological distress following abortion."

Food Safety

Public fear of pesticides means that government and industry need to do more to restore confidence in the safety of U.S. food, according to the American Chemical Society Agrochemicals Division. It has assembled industry, academic, government, and consumer representatives to hammer out steps to help achieve this goal.

The group is asking government agencies to develop uniform guidelines for assessing risks and then "come to a consensus on what is an acceptable risk level" for pesticide use in food production. A national survey of pesticides in food and feed production would provide data on pesticide exposure and trends, as would a national residue database.

Healthier Milk

An eight-ounce glass of Pro-Cal, developed by University of Illinois food scientist Munir Cheryan, has twice the protein and two-thirds more calcium than conventional whole milk. The experimental product has no additives but would require dairies to retool their facilities.

With "ultrafiltration," Cheryan uses membranes to remove unwanted material from milk. "The beauty of this process is that it changes nothing but what we want it to," Cheryan says. "We can control the fat, protein, and calcium and not change appreciably the lactose, sodium, or potassium in the final product."

Lightning Predictor

The French firm Dimensions has developed a way to monitor storms and pinpoint "lightning discharge danger zones" up to 30 minutes before the first bolts strike the ground. Based on research at the French National Institute of Aerospace Research, the technique has been successfully tested at the Landes test center in France, the Kourou Ariane rocket launching site in French Guyana, and Florida's Kennedy Space Center. The system covers 35,000 square miles.

Earliest Science Lab

Washington University mechanical engineer Andrew Dimarogonas has traced the earliest known research lab to Pythagoras. "It is generally believed that the ancient Greeks were only theoreticians." But, Dimarogonas has written in the *Journal of Sound and Vibration,* "Pythagoras employed the experimental method, upon which all science is based, and proved the natural frequency of vibrating systems."

An expert in vibrations, Dimarogonas draws on the writings and drawings of Boethius. The fifth-century Roman relates a legend that Pythagoras was struck by the vibrating tones ringing out of a metal shop. After conducting experiments, the Greek proved that the size of hammers—but not the strength of the men swinging them—affected the tone. That axiom had been attributed to Galileo.

Engineering Ethics

Neil Norman, president-elect of the National Society of Professional Engineers, has called for a conference in 1991 to address cultural, social, and ethical issues that U.S. engineers face in a global economy. "It may be quite feasible to develop a standard international code of ethics," he says. Norman thinks such a code would go hand in hand with efforts to develop reciprocity for national accreditation standards.

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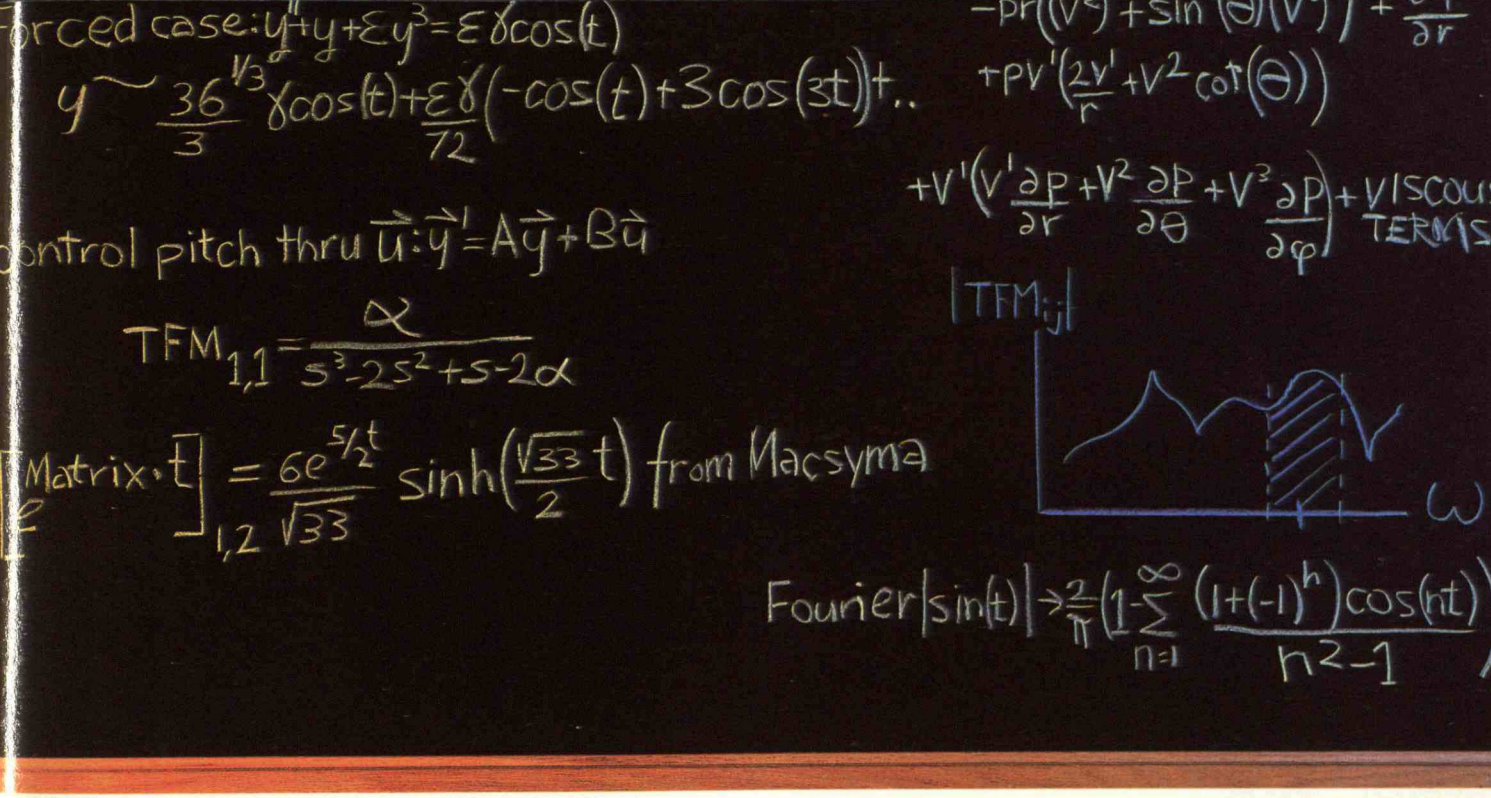

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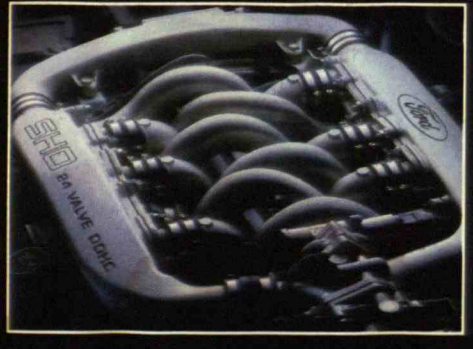

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